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WHAT IS A FILAMENT?

ELECTRICIANS are now asking themselves and each other just precisely what they may and what they may not do, without risk of interference, in the manufacture of incandescent lamps. But nobody seems to know exactly how the thing stands. For the Edison patent it has been claimed, and the claim has practically been sustained by the judgment of two out of the three superior judges before whom the matter was argued, that it includes all carbon filaments used in combination with a glass-enclosed vacuum. All carbon filaments: but what *is* a carbon filament? That is the point which requires elucidation. We do not even know now what to call a pencil or rod of carbon $\frac{1}{25}$th of an inch in diameter, such as was used by Swan. Whether a carbon stick or rod of that diameter is actually of such slenderness as to justify its being called, in the Edisonian sense, a filament is one of the questions which still remains to be decided; possibly it will come up for legal solution in one of the numerous suits for infringement which we understand to be pending. There was a suggestion in the judgment of Mr. Justice Butt that resistance might have something to do with the constitution of a filament; but nothing was made of the point by the Edison Company's counsel in the Appeal Court. And for very good reasons. Had a definite degree of resistance been laid down as being necessary before the Edison lamp could be infringed, the patent would at once have lost that delightful vagueness which is at once its greatest charm and its chief source of power. It would not have been difficult to construct a lamp possessing all the requisites for successful use which would have a resistance higher or lower than any which might be claimed for the Edison lamp. And so we heard nothing on appeal about a definite resistance. Flexibility, resiliency, elasticity, and "high" resistance were terms freely used by the Attorney-General, but he completely failed to point out any passages which warranted his use of the first two, at any rate. It will naturally be inferred that these terms were introduced to suggest as great a contrast as possible to the Swan carbon, which was rigid. But it is impossible to find anything in Edison's specification which describes these characteristics as essential parts of the invention. Lords Justices Bowen and Fry, in fact, seemed to be of opinion that it was not in consequence of the size of its conductor that Swan's lamp failed to be an anticipation of Edison's, but rather because it was merely an unsuccessful experiment. Lord Justice Cotton differed from them upon this point, for he considered that the evidence proved the practical success of the Swan lamp. His main divergence from the judgment of his colleagues, however, was as to the construction of Edison's second claim, which he held to be for a carbon filament manufactured in the manner described in the specification, a construction which might leave Edison's patent valid, and yet acquit the defendants of infringement. It will be interesting to know which view will be taken by the House of Lords—whether the word filament will be given a wider or a more restricted meaning than Mr. Justice Butt was inclined to give it, or whether their lordships will agree with Lord Justice Cotton (by no means an improbability) in construing the claim to be one for a carbon filament "made as described." We differ from the opinion expressed by a contemporary (which seems not to have obtained a proper grasp of the points at issue) that any further attempt to assail the Edison patent can only result in a great expenditure of time and money, with no practical gain to anybody but members of the legal profession, and by what process of reasoning it has been discovered that "substantial justice has been done," we are at a loss to conceive. There have been, it is true, two judgments delivered adverse to the defendants, but those judgments were based upon different grounds, and in some senses may be said to be conflicting. The divergence of Lord Justice Cotton from the opinions of his colleagues, important as is the significance of that divergence, is not, therefore, "the only inducement for the litigants to carry the case to the House of Lords." It will not, perhaps, be out of place here to suggest that much more will be gained in future arguments by directing all available force against the assumption that Edison's invention was the sole cause of that enormous increase in electric lighting which has taken place, than by endeavouring to construe some of the older specifications for electric lamps into anticipations of Edison's disclosures. No one who has followed the hearing of this case can fail to be convinced that the statements by the Edison Company's counsel that before the date of Edison's patent such a thing as an incandescent electric lamp was not commercially known, and that almost immediately after that date such lamps were manufactured by hundreds of thousands, had a very important effect upon the minds of the judges to whom those statements were made. If it were shown, as it undoubtedly can be shown, that so far from hundreds of thousands of lamps having been made according to Edison's specification, very few lamps have been so made, and that none are being so made now, one of the most cogent arguments in favour of the Edison Company would be destroyed. The Appeal Judges have already gone beyond the lines followed in patent actions recently, and it was a source of great gratification to find that the infallibility of Edison, or his patent agent, in the matter of drafting specifications is no longer accepted as a fact. We may find that the House of Lords will go yet further.

Cutting Telephone Wires.—On Sunday last week some malicious person cut the telephone wire between Dover and Folkestone.

CHAUDRON'S THERMO-PILES.

THE chief advantage of an apparatus of this kind is that it produces an absolutely constant current, which enables us in electro-plating operations (copper, nickel, &c.) to obtain deposits of a superior quality.

Thus copper plates are produced finer in grain and of greater strength than that obtained by hydro-chemical batteries or magneto-electric machines.

They can also be used for charging accumulators for lighting. The series A, employed specially for this purpose, has given most satisfactory results.

In the chemical analysis of metals they most advantageously replace the ordinary batteries.

As a source of electricity, they can be employed for all the demonstrations and applications required in lectures on physics and in chemical laboratories.

They are entirely free from the unwholesome and dangerous exhalations resulting from the employment of liquid batteries.

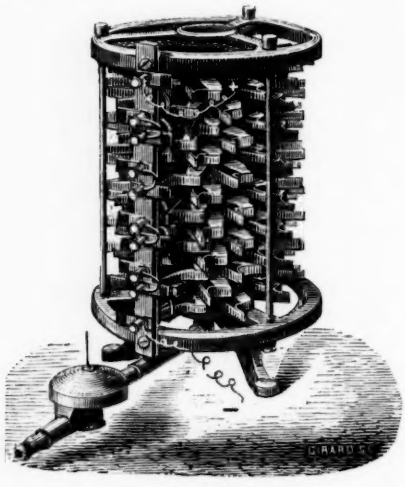


FIG. 1.

The working is of the simplest description, no maintenance is required, and the starting is most easy, as the lighting is effected like that of an ordinary gas jet. That is to say, at any moment the working can be stopped, and at the same time the expenditure, which is, moreover, very slight.

Working of the apparatus.

The gas, which is laid on by means of an India rubber tube, enters the regulator (fig. 2), which only allows the exact quantity to pass through that is necessary for the heating of the generator, and it then enters the tubing, T, furnished with the Bunsen arrangement. Thence, mixed with air, it passes into the pipe, A, which is pierced with holes, and burns in the cylindrical space, round which are arranged the thermo-electric bars. These batteries, which we understand to have been very successful in France, are being introduced into this country by Mr. J. A. Berly, and the subjoined table of tests has been compiled, we are told, by M. Hospitalier.

Fig. 1 shows the apparatus in perspective, the bars being coupled in series; fig. 2 is a vertical section of

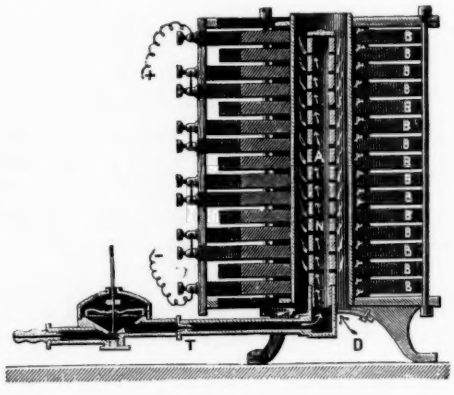


FIG. 2.

the apparatus, showing the armatures; and fig. 3 a horizontal section of the bars collected together and their armatures.

Description of fig. 2.

T. Tubing for laying on the gas.

A. Pipe of refractory earth with holes, N, through which escapes the gas mingled with air to burn in the cylindrical space.

D. Current of air, to be used for combustion.

B B. Thermo-electric bars.

r r. Discs of asbestos, serving to insulate the elements of the generator.

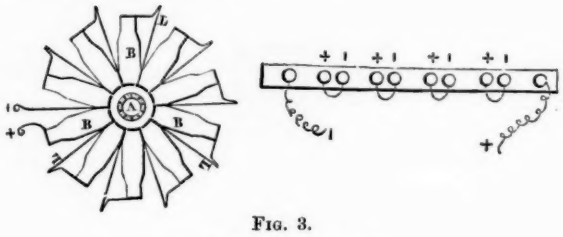


FIG. 3.

Description of fig. 3.

L L. Plates forming armatures.

B B. Thermo-electric bars.

SYNOPSIS OF THE THERMO-ELECTRIC GENERATORS.

GENERATORS.	Number of apparatus.	Number of elements.	Weight of the element.	RESULT OF THE EXPERIMENTS. Expenditure of gas per hour.	Electromotive force, E.	Intensity, I.	Resistance, R.	Deposit of copper in 10 hours.†	Price.	OBSERVATIONS.
			Grammes.	Litres.	Volts.	Ampères.	Ohms.	Grammes.	Francs.	
For electro-plating	G 1	50	200	180	3	7·5	0·40	350	180	The apparatus marked * have not yet been measured.
	G 2	60	200	220	3·5	7·5	0·46	420	210	
	G 3	100	200	300	5·5	7·5	0·73	600	300	
	G 4*	200	200	,,	,,	,,	,,	,,	,,	† These values were obtained, the battery being joined up in quantity. They would correspond for the battery G 3 to a mean rendering of 50 ampères.
	G 5*	400	200	,,	,,	,,	,,	,,	,,	
For chemical laboratories and lecture rooms ...	L 1	60	60	150	4	4·25	0·94	,,	100	
	L 2	80	60	200	5	4·25	1·17	,,	120	
	L 3	100	60	250	6	4·25	1·41	,,	150	
	L 4	120	60	280	8	4·25	1·88	,,	180	
For the charging of accumulators ...	A 1	60	150	200	4	5·5	0·72	...	150	
	A 2	80	150	240	5	5·5	0·90	...	200	
	A 3	100	150	260	6	5·5	1·09	...	250	
	A 4*	120	150	,,	,,	...	...	...	...	
	A 5*	160	150	,,	,,	...	...	...	...	
	A 6*	200	150	,,	,,	...	...	...	...	
	A 7*	400	150	,,	,,	...	...	...	...	

THE FIRST SUBMARINE TELEGRAPH BETWEEN FRANCE AND ENGLAND.

THE recently published "Lives of the Electricians," and the more recent inaugural address of Sir Charles Bright as President of the Society of Telegraph-Engineers, is calculated, in my opinion, to convey so erroneous an impression of the earliest transaction connected with the first submarine telegraph that I venture to send you a few remarks, upon the substantial accuracy of which your readers may rely.

Passing over the plan which had been previously matured by Professor Wheatstone as long before as 1840 for laying a submarine line covered with rope between Dover and Calais (see Sir C. Bright's address) merely with the remark that it is, perhaps, to be regretted that the Professor after maturing the plan should for eight or ten years have "hid his light under a bushel," I proceed to that which I believe to have been the first seriously contemplated "oceanic" telegraph.

Either at the latter end of 1845 or early in 1846, through the introduction of a friend, I first became acquainted with the brothers John Watkins and Jacob Brett; the latter was just then engaged upon his patent for a printing telegraph, the invention of Royal E. House, an American, and was including in his patent an invention of his own, which he termed an "oceanic line." Jacob Brett was at this time convinced of a great future for submarine telegraphs, and having this in mind, not only registered a company for an Atlantic line but simultaneously applied to Louis Philipe for a concession giving permission to land submarine wires from England on the coasts of France. This concession was granted, but owing to the revolutionary times on the Continent nothing could be done. During the presidency of Louis Napoleon the concession previously granted was confirmed. One of the conditions to which I would specially call attention was to the effect that "the experiment should be satisfactorily proved" by 1st September, 1850.

So soon as the Continent had settled down several fruitless endeavours were made to raise the necessary capital. *No one believed in it*—until in June, 1850, as a last chance of saving the concession, Sir Charles Fox (then Mr. Fox), Mr. Francis Edwards, John W. Brett, and myself, contributed each £500 to make up £2,000, which was my estimate of the cost. In order to put the business in proper form the concession was in June assigned to me as representing a "Societe en Commandite" which we established in Paris in order to limit our liability. The first cable, or line, was then put in hand.

Let those of your readers who are experienced in modern cable work bear in mind that I am writing of events thirty-six years ago. It reads almost as a fable to be told that the well-known wire drawers, Bolton & Sons, of Birmingham, would not undertake to supply No. 12 B.W.G. copper wire in greater lengths than 80 to 100 yards, and that more than a single covering of gutta-percha was then unknown. The indefatigable manager of the Gutta-Percha Company, Mr. Samuel Statham, assisted by Willoughby Smith, entered most warmly into the scheme. Mr. Fox's firm, Fox, Henderson & Co. (then engaged upon the 1851 Exhibition building in Hyde Park) undertook to make to my design (which I must acknowledge was a most faulty one) a large drum, or reel, some 4 feet or so wide and 8 or 10 feet in diameter, upon which the gutta-percha covered wire was to be wound. The wire was duly delivered at Wapping, and placed upon a modified form of reel about 11 or 12 feet long and 6 feet diameter, fixed amidships on the deck of the *Goliath* tug and sent round to Dover.

The course to be taken having been previously marked out by Captain Bullock, assisted by his lieutenant, Burstall, the present secretary of the Thames Conservancy, and by Mr. Webb, who was afterwards associated with so many submarine lines of telegraph. On the morning of August 28th one end of the wire was attached to the temporary piles at the stump end of the present Admiralty pier at Dover, and the expedition started about 11 a.m., pitied for our folly by some, laughed at by most, and believed in by very few.

Looking back at the arrangements I had made for placing weights upon the line—at the great strain at times brought upon the unsupported gutta-percha wire and at the imperfect insulation—it appears almost marvellous that the results should have been such as to call forth a leader in the *Times* of 31st August: "At Wednesday evening at nine o'clock the possibility of communication between France and England by electric telegraph was practically established. . . . . The jest or scheme of yesterday has become the fact of to-day. The wildest exaggeration of an Arabian tale has been outdone by the simple achievement of modern times." The object was attained; the experiment had been satisfactorily proved; and the concession was thereby saved.

It was not to be expected that an unprotected gutta-percha line could for long withstand the currents and other dangers of the Channel, but it is not a fact that the line was severed the first night after it was laid. Weak signals only would pass through; but it was on the night of August 31st that a French fisherman fishing for conger eels caught the line upon his hook, drew all the slack he could into his boat, and subsequently took 80 or 100 yards into Boulogne. The first electric *signals* between France and England were transmitted by Brett's printing telegraph; the first intelligible messages were sent by Cooke and Wheatstone's single needle.

The successful accomplishment of the task was then and there authenticated by a French engineer and one or two Custom House officers, and by the lighthouse keeper, and the *Goliath* steamed back to Dover. Although, reading by the lights we now possess, the laying of a line of only 20 miles across a Channel 160 feet in the deepest point may appear an achievement to be little proud of, yet this was the forerunner of the cables which now bring the most distant parts of the globe in hourly "touch" with us, and I confess to feeling some satisfaction at having been so intimately associated with the enterprise.

No sooner did it become known that the line was broken than the most strenuous endeavours were made by persons in the interests of the Electric Telegraph Company to induce Louis Napoleon to declare the concession void for non-fulfilment, and to throw open the right to anyone to land telegraphic cables from England on the French coast. It is within my own personal knowledge that Louis Napoleon expressed himself as perfectly astonished at the support from high quarters which the forfeiture of the concession received. He considered that those who had so far succeeded were entitled to reward, and the concession was confirmed, giving until October 1st, 1851, to lay down a permanent cable and establish a substantial line.

It would be travelling beyond the scope of my present subject—the first submarine telegraph—to give, as I might, some particulars which might be interesting of the cable of 1851, with which Mr. Thomas R. Crampton was deeply pecuniarily, and otherwise so intimately associated. When I mention that I was the "Gerant" of the French "Compagnie du Télégraph Sous-marin," and that the letter, copy of which I give below, was addressed by John Watkins Brett to the *Times* and some other papers, your readers may understand that I had opportunities of becoming acquainted with details which have not hitherto seen the light. At a future time I may, perhaps, again address you.

CHARLTON J. WOLLASTON.

[COPY.]

From "Times," September 10th, 1850.

"To the Editor of the *Times*. *September 9th*, 1850.

"Sir,—On behalf of the original promoters and patentees of the submarine electric telegraph, allow me in justice to state that the preparation and laying down of the submarine wire between France and

England has been conducted solely under the management of Mr. C. J. Wollaston, as engineer to the Submarine Telegraph Company.

"I am, sir, your very obedient servant,

"JOHN W. BRETT.

"Compagnie du Télégraph Sous-marin,
"98, Gracechurch Street."

ON CERTAIN HISTORICAL INVENTIONS LITTLE KNOWN.

By M. R. ABDANK-ABAKANOWICZ in the *Revue Internationale de l'Electricité*.

I PURPOSE entertaining you with certain electrical inventions the origin of which is very little known and the most of which date from an epoch already somewhat distant. Still it is but justice to reserve for them in the history of electricity the place which is their due. These are fragments of discoveries emanating from different enquirers; inventions which have been destined to reappear, sometimes after a slumber of twenty years, under a new name, we might say in a new edition, though sometimes neither revised nor enlarged, yet enveloped with loud reclamations whilst the true inventors remained in oblivion. Be it our business to bring them into full daylight.

In no other branch of the applied sciences have improvements succeeded each other so rapidly as in electricity. In fact, all the practical science in this region has been established during the second half of our century. This era of inventions, this deluge of devices, this heaping up of practical results obtained, have led to a powerful commercial movement which, seconded by a publicity without precedent, has so confused historical truth that in many cases the annals of electrical inventions have been rendered, if not impossible, yet at least very difficult to construct. It may suffice to remember how difficult it is to get free from uncertainty if we wish to give an account of the true origin of inventions, even in cases such as those of dynamo machines, the electric transmission of energy, the different systems of electric lighting, telegraphy and telephony, not to speak of inventions of less importance but which are still interesting for the history of science. I consider that it may, perhaps, prove very useful to collect new materials for the future historian of electricity, because with time the sources of current errors will be more and more difficult to discover, and erroneous traditions will have become deeply rooted in the public mind.

I call your attention to-day to a small series of facts which constitute a modest contribution to the history of dynamo machines. I shall on some future occasion occupy myself with the question of the transmission of energy to a distance, with instruments of measurement and with telephony.

Not wishing to introduce the question of priority, which might degenerate into unpleasant polemics and which would require an examination and a comparison in detail of inventions among themselves, I shall confine myself to a summary description of some researches, giving the exact dates of their publication (the earliest which have come to my knowledge), these dates being sufficient to render justice to the inventors. I shall not occupy myself with those who have gleaned in fields already reaped by their predecessors.

1. I will begin with the description of a small electro-magneto machine, which presents nothing striking as regards the novelty of the principles brought into play, but which is remarkable for the elegance of its arrangement, the simplicity of its construction and for a very good utilisation of the magnetic-field of a permanent magnet. In this machine there is employed a horseshoe magnet between the limbs of which revolves a bobbin of the Siemens type, the axis of rotation of which is parallel to these limbs. This combination renders it possible to obtain small machines, very compact, substantial and easily constructed. It has been of late extensively applied and is well known to you all. The inventor is A. N. Allen, who took out his patent February 2nd, 1872 (No. 123,438), almost simultaneously with the American patent for the

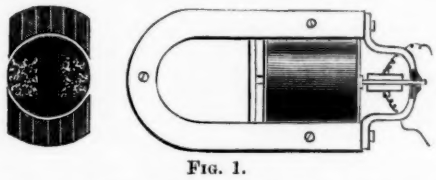


FIG. 1.

Gramme machine. In the collection of patents concerning electric machines these two patents follow each other.

2. We will now examine another invention much more important and which carries in it the germ of the great subsequent development of electric motors. It emanates from an illustrious *savant* to whom electricity owes several remarkable inventions which, unfortunately, have not been appreciated according to their merit. The machine in question is founded upon the utilisation of the attraction exerted by solenoids upon an iron core. The solenoid employed is sectioned into a series of bobbins, fig. 2, in the same manner as the induced ring of dynamo machines. As in these machines, the sections communicate with the segments of the collector, which is rectilinear in this special case as it is shown in the fig.

Upon this collector press two rubbers which comprise between them a given number of sections, and these rubbers convey the current into a corresponding part of the solenoid. If the system of two rubbers is made to glide along the collector, we obtain the same results as if a solenoid composed of n sections comprised between the rubbers is made to move in the direction of the axis.

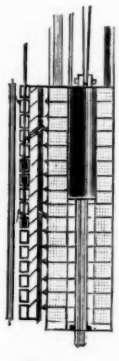


FIG. 2.

If we place in the interior of such a system a core of soft iron, it will follow the movement of displacement of the active segments and consequently it will follow the movement of the rubbers. To make of it a motor with alternate movements, it is easy to transmit automatically the movement of the iron core to the rubbers which convey the current.

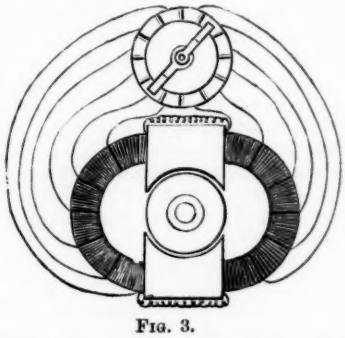


FIG. 3.

This motor was realised by Page in 1850 (*American Journal* X, 1850), and the magnitude of the forces set in action is truly imposing for the time; by causing

the core to act by the intervention of a connecting rod upon the crank of a shaft with a fly-wheel, and feeding the machine by Grove elements, he furnished work corresponding to 10 horse-power.

Let us now examine another instance of the sectionment of bobbins to the construction of electro-magnets as inductors of dynamo machines, and that in order to obtain a means of regulating the inducing field. Let us consider any machine of the Gramme type, like that shown in fig. 3. Let us cut the wrapping of the inductors into sections, and let each section communicate by the intervention of a plate of a commutator arranged like the collector of the induced. If we suppose that the current destined to excite the inductors enters by two movable rubbers resting upon this commutator we may easily eliminate certain sections by employing a suitable combination, or we may pass into certain sections a current of the inverse direction, and thus change the positions of the poles by transferring them into the limbs of the electro-magnets. This method of regulating the magnetic field of dynamos was invented by H. P. Maxim in 1882 (German patent No. 20,465), and has been often applied since by various inventors.

Fig. 4 represents a machine actuated on Maxim's system.

4. Whilst speaking of Maxim, we may further cite one of his little inventions which he published in 1881 (*Scientific American*, August 27th, 1881), and which supplies a means of demagnetising watches. This method is very simple, and is known to all electricians. The watch is made to turn in a magnetic field, and is withdrawn gently, without ceasing to turn. M. Maxim has constructed for this end a small machine which effects this simple operation automatically.

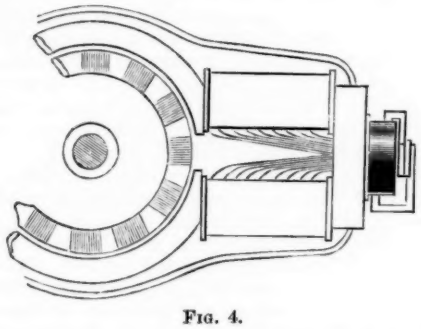


FIG. 4.

5. I will next mention a modification of the dynamo machine which was in its day much discussed, although it presents no advantage, and although it is even very defective. I speak of the use of electro-magnets with two limbs, forming two magnetic fields of inverse direction, which necessitates the use of two rings. Fig. 5 will sufficiently explain this arrangement, which is, moreover, well known at present. The description of this machine with the explanatory figure is to be found in the *Electrician*, of London (April 29th, 1882). This idea was suggested by a modest correspondent of that journal who did not try to reduce it to practice—and he did well; it has been realised by others, but evidently without success.

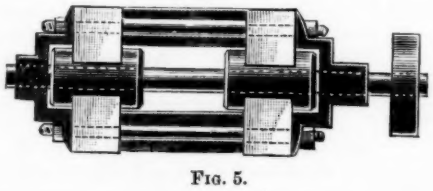


FIG. 5.

6. To finish this series I will describe an invention, if so it may be called, belonging to the sphere of the theory of dynamo machines. To give an account of the conditions of working of dynamo machines, it is advantageous to employ a graphic representation, which speaks more rapidly to the eyes than a numerical table comprising the series of figures observed in successive measurements.

Dr. Hopkinson, in a lecture delivered in April, 1879, at the Institution of Mechanical Engineers, presented his system of representation in orthogonal co-ordinates, the abscissæ being the currents in webers and the ordinates the electromotive forces which the dynamo produces at a given speed when the current which actuates it has the value of the corresponding abscissa (fig. 6).

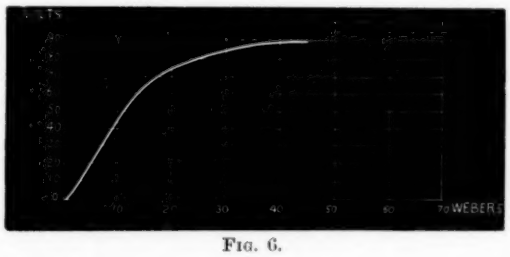


FIG. 6.

Dr. Hopkinson shows that this curve represents the variations of the current of the machine. This curve has been of real service in the study of dynamo machines.

I will close for to-day this somewhat dry review, but which I hope will seem to you not devoid of interest.

THE PARK ELECTRIC GOODS TRAIN BRAKE.

A TRIAL of the Park Electric Brake took place on December 30th, on the Chicago, Burlington, and Quincy Railroad at Burlington, Ia. The tests were made over the track on which the elaborate series of experiments on goods train brakes were made last summer.

The brakes tried on that occasion were, says the *Railroad Gazette*, all well-known by name, and with one or two possible exceptions, had been largely used in practical service for some years. The Park Electric Brake is, on the other hand, little known even by name, and has not been hitherto used in practical every-day working, either with freight or passenger trains. The inventor had, therefore, little experience as to the actual merits of his brake, and the trials may be regarded as merely preliminary to the competitive trials to be held at Burlington in April, when thorough tests will be made of the working of many well known freight train brakes which will embody all the latest improvements suggested by practical use and extended and elaborate analytical experiments.

The trial of the Park Electric Brake was therefore of a preliminary and informal character. The trials were attended by two members of the Committee of the Master Car Builders' Association on Freight Train Brakes, the chairman, Mr. Godfrey W. Rhodes, and Mr. D. H. Neal, Mr. Stewart, division superintendent, and Mr. West, master mechanic, Chicago, Burlington, and Quincy, were also present, while the records of the trial were taken by Messrs. Herr and Sargent of the motive power department.

The brake was applied to a train of 25 stock cars equipped with the Westinghouse automatic freight brake, the electric brake being arranged to use the same foundation, brake work, levers, &c. During the trial, the Westinghouse brake was cut out, and was, therefore, inoperative. In addition to the 25 stock cars (which were empty), a dynamometer car and an eight-wheeled way car were attached to the train. The electric brake was not applied to these latter cars, or to the engine and tender. During the trial the Westinghouse driver brake was used on the engine, and a power brake, either the electric or the Westinghouse driver, was used on about 67 per cent. of the total weight of engine, tender, and train. The total length of the engine, tender, and train was about 1,035 feet, and the total weight may be taken at about 775,000 lbs.

The construction of the brake may be briefly described as follows :—

A dynamo is placed on the locomotive and is driven by a small independent engine. The whole affair is easily detached from the locomotive and weighs about 400 lbs. Three wires run the length of the train, and the ends of each car are coupled together by a very simple device, one coupling serving for the three wires. The brake is non-automatic, or in other words, does not apply in case of a break-away, but it is proposed to add a storage reservoir in the way car at the rear end of the train, whereby the conductor could apply the brake in case of the train parting. As, however, applied to the trial train, the brake is non-automatic, and the current only runs through the wires when the brakes are being applied or released from the engine. Normally, when the train is running or standing with the brakes off, there is no current in the wires.

The engineer applies and releases the brakes by moving a lever on an electric switchboard on the engine. The current applying the brakes runs to the end of the train through one wire and returns through the centre wire of the three used. When the lever on the switchboard is moved to the release position the current runs through the third wire, releasing the brakes, and returns through the centre wire as before. Whenever the coupling at the end of the train is pulled apart the wires automatically make the proper connection in the coupling, so that the current when applied will make a circuit the length of the train and through the centre wire. It will thus be seen that the couplings require little attention. They are very easily coupled by a single operation, and the coupling at the end of the train is simply allowed to hang loose, and does not require to be placed in a rest or closed with a plug or a stop-cock or any similar contrivance.

The means by which the electric current applies the brake shoes on each car are decidedly open to criticism, but will be probably largely modified in the near future. As now arranged, an eccentric is mounted on one axle of each car. The end of the eccentric rod can, by means of pawls, be made to engage in ratchet teeth on the periphery of a cast-iron drum carried on the under side of the middle sills of the car. This drum also carries a chain which is attached to the brake and levers in the usual manner. The passage of an electric current along the train causes the pawls worked by the eccentric rod to engage the drum, which consequently rotates and winds up the chain applying the brake shoes. A second pawl prevents the drum running back when the pawl driven by the eccentric rod is moving back to take a fresh stroke. When the current applying the brake is stopped (by the lever or the switchboard being thrown into the middle or neutral position), the applying pawl ceases to act, but the second pawl retains the brake on. When the releasing current is passed through the other wire, this second pawl is thrown out of gear, and the brakes come off. As the details will probably be considerably modified, the above brief and somewhat imperfect description will suffice ; but it may be noted that an eccentric constantly running on a car axle is very objectionable, and that the teeth of the ratchet would be liable to be filled up with ice, snow, and mud, rendering the brake inoperative.

As the brake is applied by a few revolutions of the wheel the shoes are full on in a very short space of time and must be applied simultaneously throughout the length of a train, however long. Assuming that the brake shoes are fully applied in four revolutions of a wheel, it follows that the brake will be fully on when the train has run 35 feet. At 40 miles per hour this distance would be run in little over one half of a second. As the freight train brakes tried at Burlington last summer required from 10 seconds to 30 seconds to fully apply the brake on a freight train of 25 cars the difference is very conspicuous.

The Park brake can be adjusted so as not to slide the wheels. When the brake is applied with what is deemed sufficient force a small set screw forms a contact and shunts the current that holds the pawl applying the brakes. This pawl then drops and the brake-chain drum is no longer revolved. The brake, therefore, continues to be applied with the proper maximum amount of force and is not released, the drum being prevented from running back by the second or retaining pawl already described. This pawl can only be lifted by the releasing current or by hand.

The following were the results of the different tests :—

Speed. Miles per hour.	Distance. Feet.	Equivalent distance at 40 miles per hour.	Grade. Feet per mile.
13	132	1,248	Level
20½	462	1,760	Level
21	440	1,597	53 ft.
31	1,090	1,814	Level
38	4,664	.....	53 ft.

The distances and speed were accurately determined by the recording apparatus on the Chicago, Burlington, and Quincy dynamometer car. In the last stop the electric brake acted very imperfectly and the records given by the apparatus in the dynamometer car show that most of the braking must have been done by the engine and tender. The pawls were probably unable to act at the speed, which was very high for a freight train. The other stops were, however, very good performances, and, in point of distance compare very favourably with the results given by any other freight train brake. As the electric brake is new and hitherto untested, it is highly probable that these results can be considerably improved on in future tests.

The third column in our table gives the distance in which the train would have been stopped under similar circumstances had the speed been 40 miles per hour, the distance being supposed to vary exactly as the square of the speed. This assumption is not strictly correct, but the last column serves to show that the brake does best at low speeds. This is probably due to some defective action of the pawls at a high speed, and it is quite possible that it will disappear with improvements in the mechanical details of the brake.

The most remarkable point about the trial was the entire absence of any shock during the stops. The "slidometer" used during the Burlington trials last summer was in position in the way car, but it never moved a hair's breadth during the entire trials. Those riding in this car at the rear of the train could just feel the brake applied, the speed then gradually decreased without any jar or shock until the train came to a stand. Even the inevitable rebound when motion is finally arrested was very slight, and in some stops hardly perceptible.

Throughout the entire tests nothing about the cars was broken or displaced, a strong contrast to the long array of links, pins, draw-heads, centre plates, &c., broken at the Burlington tests. The trial of the electric brake may be taken as proving that the simultaneous and instantaneous action of a brake throughout a train will enable it to be brought to a stand without the slightest shock, even though loose couplings are used. The cars in these trials were fitted with the Potter draw-bar, with the usual links and pins.

The trial showed that the brake chains used on the drum were too weak, several being broken. The insulation of the wire conveying the releasing current was defective, and several of the brakes had to be released by hand. These defects of detail can, however, be easily remedied, and were caused by the hasty manner in which the brake was fitted up.

The brake appears to possess the advantages of lightness and cheapness of first cost. As no India-rubber or other perishable material is used, the repairs should not be expensive when experience has shown the proper proportions of the parts necessary to insure sufficient strength. Altogether the trial is very interesting and instructive, and distinctly adds to our knowledge as to electric brakes. When we reflect that freight-train brakes that have been in extensive use for many years are unable to make an emergency stop without causing serious damage to cars and lading, it

is somewhat startling to find that a new comer steps in, and, without any previous experience, stops a long train as smoothly as the most fastidious old lady passenger could desire.

For comparison with the above, we add the following tables of the best stops from 40 miles per hour on a level, made at Burlington tests in July, 1886, with 25 car trains :—

Brake designation.	Actual speed, miles per hour.	Distance run in feet after applying air.	Time to stop in seconds after applying air.
Westinghouse automatic ...	40	977	25½
American buffer	38·7	1,633	50½
Eames automatic vacuum ...	39	1,477	43¾

SECONDARY BATTERIES.*

By ARTHUR H. PREECE, Student, King's College,

MR. PRESIDENT AND GENTLEMEN,—A cell is a term applied to two metallic surfaces, sometimes called electrodes, separated from each other by a liquid by which an E.M.F. is generated for the production of an electric current.

A battery is a combination of such cells, and called "primary" when supplied with materials which directly and without any previous preparation act on the plates so as to produce such conditions as result in a current; and called "secondary" when these preliminary conditions are produced by the passage of an electric current through them.

Secondary batteries are sometimes called accumulators from the idea that electricity is stored up or accumulated in them. It is not electricity which is stored up, but chemical energy in a potential form.

Gautherot observed in 1801 that the electrodes employed in the decomposition of acidulated water were polarised, or thrown into such a condition as to give a current reverse in direction to that of the decomposing current.

Ritter, in 1803, took advantage of this fact to make a secondary battery by separating a series of gold plates with cloth moistened by acidulated water. The secondary battery was charged by a primary one of a greater number of cells than it possessed itself. Ritter tried all metals as electrodes, but found that silver, gold and platinum gave the best results.

Since that time many eminent scientific men have investigated the subject, but it was the invention of the powerful cells of Planté and the perception of how valuable an addition to the resources of electrical engineers a good secondary battery would be that raised the subject to one of practical importance.

Previously to Planté's invention Groves had shown by his gas battery that this polarisation was owing to the layer of gas in contact with the electrodes.

Planté, in 1859, showed the greatly increased effect produced by the great affinity of peroxide of lead ($Pb\ O_2$) for hydrogen, and introduced lead as the electrodes, but it was found that the conversion of lead into peroxide of lead by the action of the current occupied a considerable time.

Faure, in 1881, remedied this by coating the lead electrodes with minium or red lead, and since that period many improvements in the construction and form of the electrodes or plates have been made by Swan, Sellon, Parker, FitzGerald and others.

The form most generally used at the present day is that known as the E. P. S., and manufactured by the Electric Power and Storage Company. It is the combination of many patents.

The vessel containing each cell of this battery is usually made of glass, sometimes of wood lined with some impervious material.

The plates or electrodes are of two kinds, positive and negative, that which becomes pure or spongy lead being called *negative*, and that which is peroxidised *positive*.

Each plate is made of a grid of cast lead, the interstices of which in the negative plates are filled with litharge (Pb O), and in the positive plates with minium or red lead ($Pb_3\ O_4$).

These different oxides are used because of the economy of energy required to reduce a lower oxide, Pb O, and to peroxidise the higher one, $Pb_3\ O_4$. This conversion of the oxides into lead and peroxide of lead is called the formation of the plates.

The number and size of the plates vary according to the size of the cell. All the positive plates are welded to a lead bar painted red, and the negatives to one painted black. After formation the plates are placed in the glass vessel, positive and negative being put alternately, and as there is always one more negative than positive, a negative is the outer one at both ends. The vessels are then filled with a solution of sulphuric acid and water, the proportion generally being 1 part of acid to 9 parts of water.

To separate the plates and to prevent buckling, which I shall refer to later on, small plugs of India rubber, which are imbedded in the plates, are used, and placed at different points between them. A sheet of thick glass is placed at both ends, and the whole number is bound together with stout bands of India rubber. To keep the plates from touching the bottom of the glass vessel two triangular pieces of teak are placed longitudinally, upon which the plates rest, and thus a space is left at the bottom where falling particles of Pb, or $Pb\ O_2$ and such like may rest without risking a short circuit between two plates.

At opposite ends the positive and negative bar pieces are allowed to project in order to facilitate the connection of the cells together, which is usually done by soldering or clamping them. The cells are connected together so that the positive bar of one is connected to the negative bar of the other as in a primary battery.

There are two sized plates made, the large size, or L type, and the small size, or S type, which is now almost out of use. The plates of the L type are 10 inches by 9½ inches by ¼ inch in the positive and $\frac{3}{16}$ in the negative, and five sized cells of this type are now made, namely, those respectively with 23 (16^{-ve} and 15^{+ve}), 15, 11, and 7 plates.

The following is a list of the different weights, &c., of the different sized cells :—

Number of plates.	Charging and discharging currents.		Capacity.	Weight.
7 L	10—12 amp.	1—15 amp.	110 amp. hrs.	70 lbs.
11 L	15—20 ,,	1—22 ,,	185 ,, ,,	98 ,,
15 L	20—25 ,,	1—30 ,,	330 ,, ,,	122 ,,
23 L	32—37 ,,	1—46 ,,	500 ,, ,,	180 ,,
31 L	44—50 ,,	1—60 ,,	660 ,, ,,	237 ,,

The glass cells at our house are insulated on shelves 6 inches or so above the ground and laid in a bed of sawdust about 1 inch deep. To keep the spray from flying about square pieces of glass are placed slanting on the top of each cell, thereby allowing the spray to collect and drop back again into the cells.

It is necessary that a secondary battery should be placed in a room separated from the engine or dynamo on account of the fine acid spray given off. The room should have also plenty of ventilation, and cells so placed that it is easy to see how they are behaving. The cells should be put together as soon as possible after arrival, the cells being carefully soldered and clamped together; but the solution, the specific gravity of which must be 1·15 (easily measured by a hydrometer), should not be added until the engine and dynamo are quite ready to begin charging.

The size of the engine and the dynamo depends, of course, on the size of the cell, and in reckoning this,

* Read before the King's College Engineering Society February, 1st, 1887.

one takes the E.M.F. of each cell as 2·5 volts and the current required at about 1·15 ampères per plate, so that with a battery of 26 cells of the 15 L type, a dynamo is required which would give at least 65 volts and 20 to 25 ampères. The first charge given should be as long as possible without cessation until the specific gravity of each cell has risen to 1·180. In any case nothing should be taken out before this point is reached.

F ortesting the cells one ought to have a *voltmeter* to measure the E.M.F. between the terminals (V in the diagram), an *ammeter* to measure the current that is being put in or taken out (marked A), an *indicator* (I), to show in the engine room the direction in which the current is flowing, in case the current from the cells should reverse the dynamo ; an *automatic cut-out and in* to prevent such a reversal, which would naturally harm the dynamo, and is also rather likely to happen if the engine is a bad-tempered gas engine. Two or three *hydrometers* to read the specific gravity of each cell and thus tell how each one is behaving. For if the specific gravity falls below 1·15 it shows that the cells are low and must be recharged, and below this point they should never be allowed to go ; and if the specific gravity rises during charging to 1·210, it is a sure sign that the cells are sufficiently full.

To find the internal resistance of the cells, which is rather a useful fact to know, this formula is used—

$$\rho = \frac{E - e}{c}$$

The proof of which is very interesting, and is this :—

Let A, B represent E, the E.M.F. of the battery at rest, and A, C = the resistance, R.

Then the ordinates drawn from A, C to B, C will represent the variation in the E.M.F. at every point as R varies.

Let A, D represent, ρ, the internal resistance of the battery.

Then D, F will represent, "e," the E.M.F. of the battery when ρ is in circuit and a current is being taken out.

Then, by Euclid, as D, F is parallel to A, B.

$$E : e :: R : R - \rho$$

$$\therefore E(R - \rho) = eR$$

but by Ohm's law $R = \frac{E}{c}$

$$\therefore E\left(\frac{E}{c} - \rho\right) = e - \frac{E}{c}$$

$$\therefore E - c\rho = e$$

$$\therefore \rho = \frac{E - e}{c}$$

As an example, the other night our battery's E.M.F. with no current on = 53·5. But with a current of 15 ampères = 52·52.

$$\therefore \rho = \frac{53{\cdot}5 - 52{\cdot}52}{15} = \frac{{\cdot}98}{15}$$

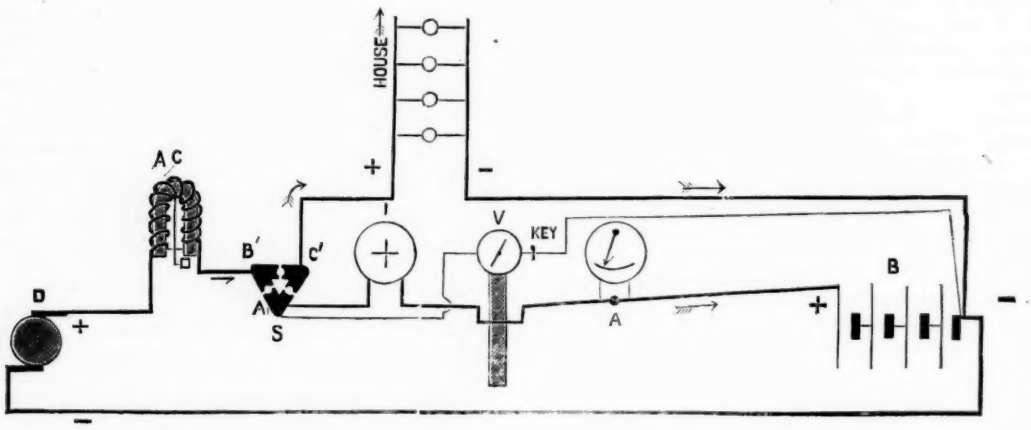
$\therefore \rho$ or internal resistance of the battery (26 cells) $= {\cdot}065^{\omega}$ and $\therefore$ internal resistance of each cell $= \frac{{\cdot}065}{26} = {\cdot}0025^{\omega}$

The following facts show when the cell is fully charged :—

1. A stream of bubbles of gas given off and a milky appearance of liquid.
2. Maximum density of liquid, viz., 1·210.
3. Increase of E.M.F. to 2·5 per cell.
4. Reduction of current.

When a battery is fairly discharged and wants charging it is shown by

1. Formation of Pb SO_4 and consequent diminution in the density.



D = dynamo.
A C = automatic cut-out.
S = two-way switch.
I = indicator.
V = voltmeter.
A = ammeter.
B = battery.

When A′, B′ are connected dynamo is on to battery. When A′, C′ are connected battery is on to house. When A′, B′, C′ are connected dynamo is on to house and battery.

2. Decrease of the E.M.F.
3. Increase of ρ, or internal resistance.

Last Saturday our battery was charged, and the following facts are interesting :—

The engine ran 9 hours. The E.M.F. rose when charging from 57 to 65 volts ; it fell, as usual, to 53·5 after the charging was finished. The current began at 16 ampères, rose to 20, then fell to 17. The density of one cell rose from 1·192 to 1·204, and another 1·194 to 1·210, and so on with others. The total ampère hours put in = 180.

The engine is running to-day, the E.M.F. having fallen to 52·5, and the density of those two cells, as of others, fallen to 1·190 and 1·192.

This last month the battery has been charged 15 times, the total ampère hours put in = 2,146, and those taken out 1,864, showing an efficiency of 85 per cent., about. This battery we have had now exactly twelve months ; it has been used regularly, and charged and discharged carefully. There has not been any trace of a fault and it has given an efficiency of about 85 per cent.

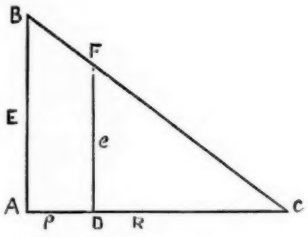
It is also interesting to know that the density of the liquid in the cells has risen slightly, for now, when fully charged, some cells rise to 1·228, while some time ago they were full at 1·202. This fact was not noticed before and is, no doubt, due to using glass covers, whereby the acid does not fly off in spray and be wasted.

The main difficulties connected with secondary batteries are these, though some can be remedied, still the batteries have not yet reached perfection.

1. Destruction of the lead grid or conductor, caused most likely by oxidation, and can be prevented by always fully charging and never completely discharging the battery.

2. Buckling, due to the excessive formation of lead sulphate, and prevented by giving an overcharge when first used and generally careful charging and discharging.

3. Separation of active material through not enough sulphate being formed. If the cells are not charged or discharged too rapidly this may be prevented.



Among lesser faults are local action and thus loss of energy, short circuiting, from buckling and material falling out, and imperfect joints, all of which may be avoided by considerable treatment.

The chemistry of secondary batteries is a most important subject, but too complicated for me to go into here; in fact, at present, authorities cannot agree as to what actually goes on in a cell. Still, I think a general idea of the probable action can be shown simply.

Suppose the battery partly discharged and ready for recharging. Then on the negative plate there is principally Pb SO_4 (lead sulphate), and on the positive plate Pb O (lead monoxide). The charging current splits up the Pb SO_4 on the negative plate, and also some water; this equation shows the result

$$\underset{-}{Pb\,SO_4} + H_2O + \underset{+}{Pb\,O} = \underset{-}{Pb} + H_2SO_4 + \underset{+}{Pb\,O_2}.$$

The lead on the negative is in a spongy form, and there is peroxide of lead formed on the positive plate.

Again, when a cell is discharged precisely the same happens, though *vice versâ*. The Pb O_2 being charged, and the spongy lead becoming Pb SO_4,

$$\underset{-}{Pb} + H_2SO_4 + \underset{+}{Pb\,O_2} = \underset{-}{Pb\,SO_4} + H_2O + \underset{+}{Pb\,O}.$$

This is, of course, by no means the complete action, for, as a matter of fact, sulphate is formed to a slight degree on both plates, and the Pb O formed by the discharge is more probably in a hydrated form, but I think it will give a general idea of what takes place.

The evolution of gas when a cell is fully charged is said to be due to the excessive current decomposing the water present; anyhow, the gas given off is explosive and is therefore a mixture of H and O.

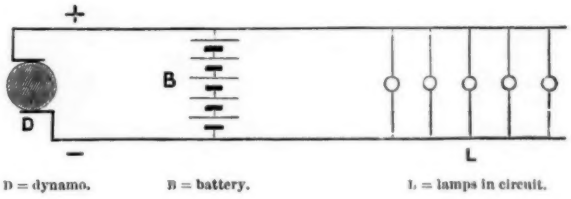
I have said before that a rise in density takes place on charging, and a corresponding fall in discharging. This is no doubt due to the formation of Pb SO_4, for when charging the Pb SO_4 on the plates is split up and the SO_4 goes to strengthen the solution, causing a rise in density. During discharge the opposite takes place, the acid being weakened and the density, in consequence, falling. The gradual general rise in the density of the solution in our battery is also due to the fact that all the Pb SO_4 formed on the plates during the process of manufacture has not yet been dissipated.

Besides the E.P.S. battery there are a good many others in existence, of which I may mention Elwell-Parker and Planté's as being in the first rank, the former almost the same as the E.P.S, while the rest of any note are Pitkin's, Swan's, and FitzGerald's—the latter of which, under the name of the "Union" battery, is now making some stir in electrical circles.

The uses to which secondary batteries are put are various, and as yet by no means fully developed.

As regulators.—In large installations, if a secondary battery is put in parallel as a lamp (as in diagram) a perfectly steady light is produced when the battery is charged, and no governor is required on the engine and all the current which is not wanted is stored in the battery.

As accumulators.—When thus used for private installation the comfort gained, beside a certain saving in running expenses, is wonderful; there is a steady light, an inexhaustible supply—which is always at hand—no noise from the engine, no extra wages or attention required at night.



D = dynamo. B = battery. L = lamps in circuit.

With a gas engine one has to turn it off at a certain hour when one goes to bed, and then no more light is available. With accumulators the gas engine may be run in the daytime and any man can attend to it, coming from his work every hour or so to see that all is right. A gardener, butler, stableman or coachman are all able to do this without extra labour.

For transport.—This is, perhaps, the great use in the future for secondary batteries; at present electric lighting is not developed enough for the purpose. In time our weekly supply will be brought round from some centre. Tramways are already driven by them. Boats, such as torpedo, submarine, or even pleasure launches will be driven by them, with no smell, heat, or much labour. As portable lamps, miniature secondary batteries are already appearing and daily improving. For miners they will be invaluable as a preventive of explosion. For telegraphic purposes secondary batteries are found of great use. A great many circuits can be run off one cell, and thus costing much less than primary batteries. In the Post Office they have now a great many circuits worked by this means.

The great drawback in having secondary batteries is, perhaps, the price, which seems rather high, a 15 "L" cell costing £3, which brings the price of a battery into high figures. They certainly are a luxury, and like all such one has to pay heavily for them; but at the same time they do save considerably the working expenses of a private installation, no extra wages for night work being required. The engine and dynamo by running, in the winter for instance, three days a week of ten hours each = 30 hours charges the battery completely, but if run every day it means at least $7 \times 5\frac{1}{2} = 40$ hours of running, showing a distinct decrease in gas expenditure, &c. In summer the engine need run but once a week, while the most ever required is three times a week, or perhaps seven a fortnight.

THE ELECTRIC LIGHT INDUSTRY IN AMERICA IN 1887.

THE rapid development of the electric light industry, writes Mr. T. C. Martin, in the *Electrical World*, is beginning to attract the attention it merits. There are croakers still to be found, as there ever will be, but when nearly every one of the local companies already established is increasing its plant, and when new companies are organising at the rate of ten or fifteen a week, it is safe to assume that the industry is on a solid basis and has a great future. The only element of instability that I can see lies in the certainty of great and even radical improvements in lamps and methods of distribution. Such instability is desirable. From dynamos, however, giving 90 to 95 per cent. efficiency, little more can be hoped or asked.

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I believe no figures are extant as to the magnitude of the industry and the value of the investment in it. Indeed, where growth is so rapid and widespread, it is difficult to follow it up and keep the record complete. But there is data from which a very near approximation can be made. At the present time about forty "parent" companies are supplying dynamos and lamps, in most cases both, and many of them furnish incandescent as well as arc apparatus. Of these companies at least thirty are actively employed, and hence a high rate of general increase is maintained. These "parent" companies had at the beginning of 1886 supplied over 25,000 arcs and 200,000 incandescents in isolated plants, and had as offspring about 450 local lighting companies. During the past year, as the columns of the *Electrical World* show, not far short of 400 new local companies were projected or organised, and on the very reasonable supposition—borne out by the facts—that at least half of them began business or are equipping for it, we get a total of from 650 to 700 local electric lighting companies at work to-day in America. Moreover, the gas companies have in a most remarkable manner evidenced their appreciation of the electric light—by undertaking themselves to supply it. At the beginning of 1886, a score of gas companies were operating electric lights. The number now is at least double. The new converts are companies at Boston; Charlestown, Mass.; Saratoga, N.Y.; Waltham, Cottage City, Newton, Dedham, Hyde Park, Marblehead, Woburn, Clinton, Roxbury, Newburyport, all in Massachusetts; Burlington, Vt.; Schenectedy, N.Y.; Cohoes, N.Y.; Peru, Ind.; Selma, Ala.; Oakland, Cal.; Orange, N.J.; Seattle, W.T.; Racine, Wis.; Woonsocket, R.I.; Winsted, Conn.; Keene, N.H.; Concord, N.H.; Nashua, N.H., and others, bringing up the list of electric lighting gas companies to over fifty. This feeling on the part of the gas companies, too, is only just at the outset of its manifestation.

The arc department of the business is the more important. As stated above, a year ago over 25,000 arcs were in use in isolated plants, and the total number, including central stations, &c., was put, in an estimate then presented to the National Electric Light Association, at 95,000. Mr. W. H. Preece, who had special facilities of observation during his visit to this country in 1884, said in a paper read at the close of that year, before the Society of Arts, that there were then probably 90,000 arcs burning in this country every night. The number at the close of 1885 may, therefore, be taken on an extremely conservative estimate at 100,000. This would indicate an annual doubling of the business from 1881—2 up to that time. At the beginning of 1881, the Brush Company had about 5,000 arc lights burning in America, which represented then 75 to 80 per cent. of the total number in use. The rate of growth is as follows :—

1881–2	6,000	1884	48,000
1882	12,000	1885	96,000
1883	24,000		

If the same rate were carried out for 1886, the total of arcs in use to-day would be no less than 192,000. But it would not be fair to expect an annual increase of 100 per cent. on so large a business. Taking, therefore, only the rate of the previous year, or 40,000 lights, we get a total of at least 140,000 arc lights. While some of the parent companies are averse to making statements with regard to the extent of their output, such figures as are obtainable more than confirm this striking total. An analysis of the figures of a year ago shows that in 60 of the larger and more progressive cities of the Union, the central station capacity was nearly 40,000 arc lights. In over 80 towns and cities were stations with an average of about 150 lights, and there were nearly 70 with stations between 50 and 100 lights. This, to go no further, and including the isolated plants, brings the number 12 months since well up to 100,000, if not over, for the total.

In order to get at some approximate idea of the outlay on these lights, a 50-light unit may be taken, as that would represent the maximum size of by far the larger number of plants of all kinds. Plants to-day often cost from one-half to one-third less than they did two years ago, but an average of $15,000 per plant of 50 lights, complete, *i.e.*, inclusive of plain lamps, dynamos, all regulating apparatus, engines, boilers, smokestack, and the like, would be near the mark; and though street wiring, in the case of central station work, might be put at, say, $300 a mile, the figure will serve, in the gross, as well for central as for isolated lighting. Such a basis of calculation yields the sum of $42,000,000 actual investment in arc lighting apparatus. This is substantiated by the authoritative estimate, made in 1884, that the direct investment in the Brush business as a whole was $25,000,000.

The increase in the incandescent lighting business has been equally phenomenal; the growth of the Edison system, for example, under its present management, has been simply tremendous. There were in August last 702 isolated Edison plants with 181,463 lamps, the growth having been as follows :—

1881	5,122	1884	98,020
1882	29,192	1885...520 plants	132,875
1883	64,856	1886...702 „	181,463

At the same date, in 1886, there were 58 Edison central stations with 149,900 lamps. This makes a total of 331,663 lights. The increase has been maintained, as, when returns were taken just before the close of the year, the total was over 387,000, or, if the lamps actually placed in isolated plants were taken instead of the mere dynamo capacity, we get a total of over 500,000 Edison lights in use in America.

The other incandescent companies make also a notable showing, and the statistics indicate that they have placed at 130,000 to 150,000 lamps—the Westinghouse Company, for instance, organising a dozen central stations, with some 15,000 lamps, in the last year, to say nothing of isolated work.

As a basis of estimate, therefore, it should be fair to take 550,000 incandescent lamps. The cost of complete installation, for both central and isolated work, may be put at from $25 to $30 per light, according to circumstances. This gives, at $25, an investment of $13,750,000.

A great many of the arc and incandescent companies have built their own stations. The value of the property employed and owned by the companies, between 600 and 700, may be put at $10,000,000. It is by no means unusual for $15,000 to $25,000 to be spent on a station building.

In the manufacture of arc lighting apparatus large sums of money are invested. One company alone has a capital of $3,000,000. It would, therefore, be moderate to put the 20 parent arc companies at a total value of $15,000,000. The parent incandescent companies are placed low at $10,000,000. Next to be considered are the carbon manufacturers, whose business has increased marvellously, from the fact that their product is one of daily consumption. The 12 concerns active in the business would probably capitalise at $10,000,000. Then come the makers of fixtures, globes, towers, poles, mast-arms, &c., representing another $10,000,000. A very large proportion of steam engineering relates now to the industry very directly, in engines, boilers, heaters, pumps, gauges, belts and the like, valuing at another $10,000,000 capitalisation; and it is not to be forgotten, under this head, that over 15,000 horse-power are derived from turbines for electric lighting purposes. The capitalisation of the wire and cable manufacturers, of underground material and conduits, of switches, tools and the various necessities of a dynamo room would reach at least $20,000,000. And last come the patents.

Of these the Edison Company alone has more than 300, while other leading companies are similarly equipped. During 1885, over 400 patents were taken out of direct bearing on electric lighting. The cost and value of all electric lighting patents may be put at $10,000,000.

I have so far taken into account only such investments and capitalisations as belong to the industry,

within the narrowest limits. Nothing is allowed, for example, for testing instruments, buggies and horses for patrolling lines, office furniture and other items which are essential to the work, and which, though perhaps small in each case, tell up when taken in mass for several hundred companies. Nor is any allowance made for the various electric motor companies, with a capital of several millions, running over 5,000 motors and at least a dozen street railways.

The total of investment and capitalisation comes out thus :—

Direct investment in local arc lighting ...	$42,000,000
Direct investment in local incandescent lighting	13,750,000
Real estate	10,000,000
Capital value of arc lighting manufacture ...	15,000,000
„ „ „ incandescent „ ...	10,000,000
Capital value of carbon manufacture ...	10,000,000
Capital value of manufacture of fixtures, globes, towers, poles, mast-arms, &c. ...	10,000,000
Capital value of manufacture in steam engines, boilers, heaters, pumps, turbines, gauges, &c.	10,000,000
Capital value of manufacture of bare and insulated wire, cables, underground material, conduits, switches, tools, &c. ...	20,000,000
Value of patents	10,000,000
Grand total	...$150,750,000

That is to say, an industry too insignificant for the serious attention of the last census returns, now represents a cash value, roundly, of $150,000,000, not on the basis merely of capital stock but of actual investment, manufacturing plant, and goodwill. I am not aware that any one of the above items can be considered excessive. The doubt is admissible whether the estimates do not fall short of the mark.

This great electric lighting industry, taken as a whole, is in good financial shape. The Edison local companies are almost all of them doing well, and some of them are earning handsomely. In the arc lighting field, there have been many instances of unfortunate and ruinous competition, but the reports from every part of the country indicate a fair measure of prosperity. In several instances, where business is now well organised and skilfully conducted, the profits are undoubtedly large and well deserved. Much of the money made by the local companies has gone in extensions of lines and increase of plant—a satisfactory indication of faith on their part in the future of the business. Moreover, the companies, as occupants of the field, with their circuits run and their familiarity with the subject of dynamo electricity, stand ready to develop the new electric motor industry, and are, in fact, more and more occupying themselves with it. As to earnings in the arc lighting field, a calculation may be made. About 100,000 arcs are burning nightly on street and commercial service. They burn, say, 329 nights in the year, allowing three nights monthly for moonlight. The average earnings are, say, 40 cents per night. This would yield $13,160,000 a year. Allowing 75 per cent. for working expenses, this would be $3,290,000, on a capital value of, say, $35,000,000, or not quite 10 per cent. per annum. It is to be remembered, however, that a great many commercial lights are not called for steadily the year round.

AN INTERESTING ELECTRIC LIGHTING STATION.

THERE is at the present moment to be seen in full operation a little central station in the middle of London which was established so long since as 1882 for the supply of arc and incandescent lamps to customers in the neighbourhood. This nearly, or wholly forgotten source of electrical supply is situated in Whetstone Park, High Holborn, at the back of the Inns of Court Hotel, and working operations were commenced with the modest total of six arc lamps, supplied to Messrs. Baker & Co., the well-known outfitters. Since that period the output has been steadily increasing, and although the station is too limited in size to serve a large number of consumers, the progress made has been considerable ; in fact, we imagine that the maximum supply has been almost reached. What is more important than all, however, is that the station appears to be a paying concern, and it is a wonder to us that there are not more installations of the kind to be found in London and other large towns.

The plant employed consists of a 25 H.P. nominal Robey engine, four Pilsen series dynamos for arc lighting, three Pilsen shunt machines for incandescent lamps, and 56 cells of 31 plates each of E.P.S. secondary batteries. These latter, however, have only recently been placed in position.

The number of arc lamps in daily, or, more correctly speaking, nightly use, is 32, and of incandescents nearly 200. These are used in the Inns of Court Hotel ; by the Inns of Court Clothing Company ; Chas. Baker and Co. ; Messrs. Kino ; Hoare and Sons ; Stanley, the well-known mathematical instrument maker ; and several other firms. The arcs are of the well-known Pilsen type, and the incandescents are mainly Gatehouse lamps of 100 volts, the remainder being Edison-Swan.

The rent per year per arc lamp is £30, and the revenue from this source alone amounts to £960 per annum. For the incandescents, if used all day, £3 is charged, if for night service only, £2 10s. yearly. We do not know how many are all day lamps, but we do not think we shall be far wrong in estimating that the yearly income for glow lamps is close upon £500, even if it does not exceed this sum. We cannot say what the working expenses are, but the station appears to us to be economically, and, at the same time, efficiently organised and supervised.

It is, and has been from the beginning, in the charge of Mr. A. J. Howes, who deserves much credit for the manner in which he has so long carried out the duties which have devolved upon him. Like the farmer's horse, the station is not much to look at, but "it's a good 'un to go," and one might spend a worse quarter-of-an-hour than by calling in upon Mr. Howes and inspecting the arrangements which we have briefly sketched.

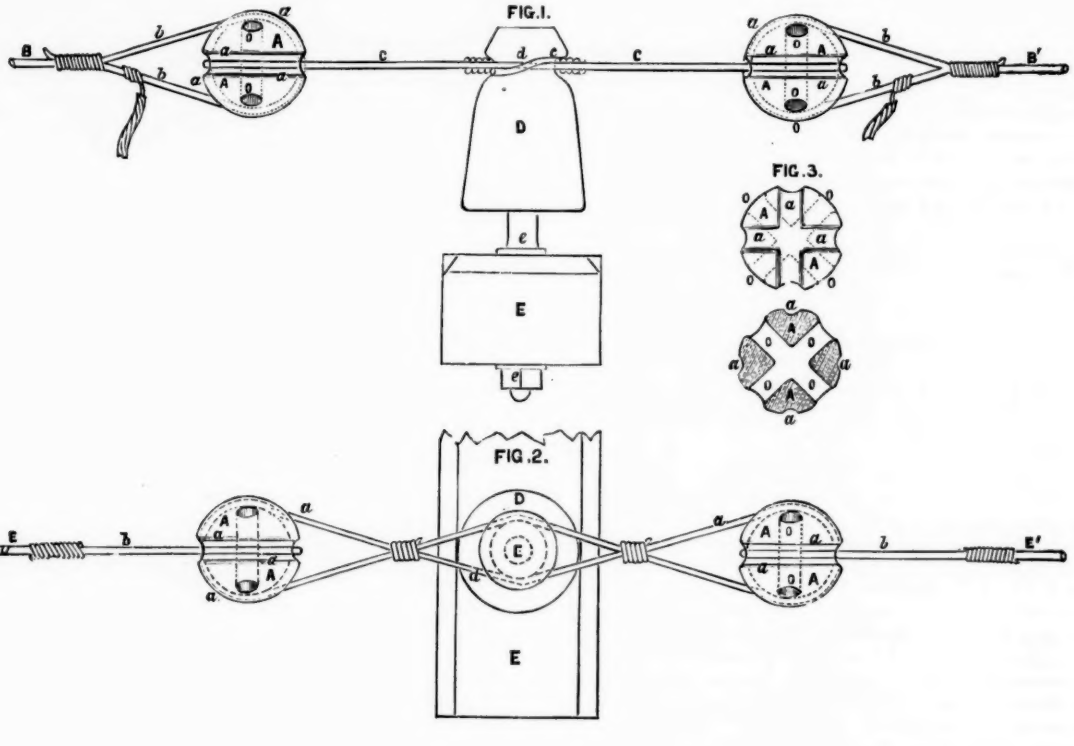
We may add that in addition to the machinery above-mentioned there is an 8 H.P. nominal Ruston and Proctor engine, and a 100-light shunt dynamo, so that in case of the E.M.F. of the cells getting low they can be further charged without interfering with the Robey motor. The first dynamo, which was fixed in 1882, is still running as merrily as ever, and looking to all outward appearance in perfect condition, and we learn from Mr. Howes that it has not yet required any repairs. This is the oldest station belonging to the Pilsen-Joel Company, and the best testimonial to the service supplied lies in the fact that the company has not lost a customer since the very commencement.

We believe that there is a desire for numbers of central stations on lines such as we have just mentioned, and we feel convinced that if a suitable spot could be found in the neighbourhood of Cheapside, and within a reasonable distance of that thoroughfare, at a comparatively cheap rental, three shops out of every four would gladly avail themselves of the advantages of the electric light. We ourselves know of one large establishment, the proprietor of which would gladly take on the electric light, even if more than double the price of gas were charged, he having no convenience on his own premises for a private plant.

Retort Manganese Steel. — We have seen some very remarkable experiments made with specimens of the manganese steel, to which we referred in our last issue. We would suggest that those of our readers who feel interested in this material should call upon Mr. Bennett, the courteous and obliging manager of Messrs. Pfeil's large establishment, who will be pleased to give every information on the subject, which is certainly of great importance to users of iron or steel.

GILBERT'S SHACKLE INSULATOR.

THIS insulator is the invention of Mr. A. E. Gilbert, telegraph superintendent of the Highland Railway Company. Fig. 1 is a side elevation and fig. 2 a corresponding plan, showing the construction of the new shackle insulator, A, *a*, and one mode and means of applying the same to the terminating ends, *b*, *b*, of two spans of aerial or overhead telegraph wires, B, B^1, at an intermediate terminal station or other support, *e*, E, and post. Fig. 3 shows an end view and a corresponding transverse section of the shackle insulator, A, *a*, as detached from the line and securing wires B and C. The point of novelty in the invention consists in the construction of an insulator in the form of a shackle ball, A, *a*, preferably formed of porcelain or other vitrified clay, glass, ebonite, vulcanite, wood, or other material which will insulate the electric wire or current. This insulating shackle ball, A, is formed with two annular grooves, *a*, *a*, round its circumference at right



angles to each other and of a convenient depth to receive the wires. The end, *b*, of the line wire, B, is looped round the one groove, *a*, and the shackle or securing wire, C, for tightening up and receiving the strain of the line wire is passed or looped round the other groove, *a*, quite separate and insulated from the line wire, B. Through the solid parts of the ball, A, between the grooves, *a*, *a*, two holes, *o*, are formed at right angles to each other for the purpose of lightening and facilitating the baking of the balls when made of clay or ebonite. The securing wire, C, of this improved insulator, A, *a*, when made in the form of a wire shackle, is passed through and secured by a separate wire, *c*, to a groove, *d*, of any ordinary upright or other cup insulator, D, fixed on the support, *e*, E, as shown in figs. 1 and 2.

Lightening his Darkness.—The King of the Sandwich Islands is arranging for an electric light installation in his palace at Honolulu. The Thomson-Houton system is to be employed, and the wiring has been secured by the Callender Company, of New York.

UNDERGROUND versus AERIAL TELEGRAPH LINES.

THE recent collapse of the telegraph system of the United Kingdom owing to the severe snowstorm and gale, is not likely to be soon forgotten, though the temporary inconvenience which was caused by it has been practically now put an end to. Until the whole of the damage has been repaired, it will be difficult to say what the cost of the misadventure will be to the nation. The result of the breakdown naturally brought out numerous suggestions from the unscientific public for replacing the overhead by underground wires, these suggestions being almost entirely of the most absurd character and evincing an utter ignorance of the very numerous conditions which regulate the possibility of adopting generally an underground system.

It must be obvious that there are three possible systems of inter-communication, viz., first, an aerial; second, an underground; and third, a mixed aerial and underground; by the latter we do not mean particular telegraph lines which individually consist partly of open and partly of underground work, but of independent lines of communication between the same towns, some of which lines are wholly underground, and others overhead (or overhead with a portion of underground work on their route).

At the present time in England the amount of underground work in use is by no means inconsiderable; nearly 20,000 miles are in existence, of which 12,000 miles are in the London district alone. Practically, the whole of London is telegraphically served by an underground system, so that the various parts of the metropolis, although they may be cut off from outside communication, will always be in inter-communication with each other.

The only extensive system of underground communication between two towns, is that which was laid down some years ago between Manchester and Liverpool *via* Warrington, a distance of 36 miles, and which consists of 14 wires. Most of these wires are used for local traffic, the remainder forming a link only in one of the chains of trunk wires running from London to the North. A considerable system of underground wires for

telephonic purposes is also in existence in the Newcastle district, of which we shall have more to say hereafter.

In the general question of underground wires we have to consider "cost" and "working capacity." The former question has to be considered under the aspects of prime cost and cost of maintenance. The possibility of placing wires underground, irrespective of their working capacity and cost, is not a doubtful question, experience of 30 years having amply proved that a complete system of any extent can at once be laid down and maintained in working order if required to be done; this experience has also amply proved that of all the fantastic as well as the apparently promising schemes which have been suggested and tried and whose name is legion, the only one that has proved to be successful is the one at present adopted by the Post Office; it is in fact but one more example of the survival of the fittest. It is not for one moment suggested that possibly some other successful system may not at some future time be brought out, or that the present one is by any means perfect, but the adoption of any new system must be a work of time, so that what is likely to turn out a success may not, after all, prove an eventual costly failure.

The cost of overhead telegraphic lines varies according to circumstances, but generally speaking a trunk line along a main road can be erected at an expense of £30 per mile for poles, and £5 10s. per mile per wire for wire of No. 7½ B.W.G., the wire being of best galvanised iron. Excluding the extra expenses incident to exceptional breakdowns, the cost of maintenance is usually taken at £1 per wire per mile per annum. This figure is the result of many years' experience, and is not likely to be subject to any material variation, as it is not probable that any improvements can be made in the overhead system which will materially reduce maintenance cost.

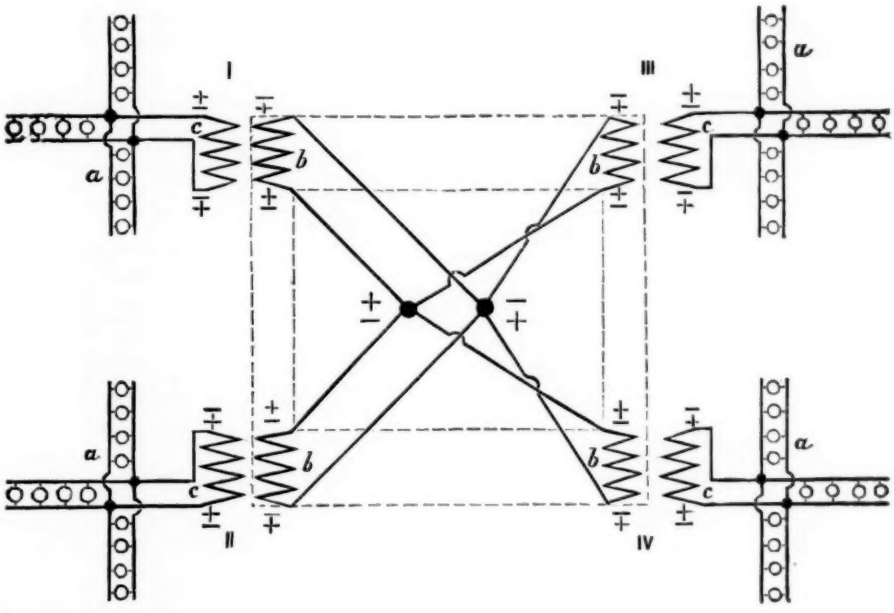
The underground system now so extensively adopted by the Postal Telegraph Department consists, as is generally known, of iron pipes with openings (called flush boxes) at intervals of 200 yards, the pipes usually containing copper wire of No. 18 B.W.G. insulated with gutta-percha to No. 7½ B.W.G., the gutta-percha being covered with a lapping of ozokerited tape; recently No. 16 copper covered to No. 4 gutta-percha has been used, and is likely to be extensively employed. The cost of the system as regards the piping is, for a pipe to contain 14 wires, generally estimated at £430 per mile, this cost including the cost of all materials, opening out and filling in trenches, replacing paving, &c. This amount varies to some extent according to the nature of the ground in which the pipes have to be laid and whether the pipes have to be placed in country roads where there is no paving, or in towns where stone flagging or asphalte paving have to be dealt with, but the price named represents a fair average. For a larger number of wires, say about 60, the total cost would be about £20 per mile per wire inclusive of everything.

(To be continued.)

SIEMENS AND HALSKE'S SYSTEM OF ELECTRIC CURRENT DISTRIBUTION.

THIS invention relates to the method of distributing electric currents to various distant points of consumption by providing at such points or stations induction apparatus, the inducting coils of which are worked by alternating currents from an alternate current generator at the main station, the induced currents of such apparatus being made to supply the electrical energy required for consumption in branch circuits at such stations.

For carrying out this method of working, the induction apparatus have hitherto either been all arranged in series upon one and the same main circuit of the current generator, as in the well-known Gaulard and Gibbs system, or they have been placed upon branches arranged in parallel arc upon the main circuit, as proposed by Zipernowski, Déri and Blathy.



In both these arrangements certain disadvantages arise in respect of the regulation of the inducing currents supplied to the several induction apparatus and of the induced currents proceeding from these to the several branch circuits, so as to insure their being in such proportion to the required consumption of electrical energy therein as to maintain a uniform tension at the lamps, which disadvantages it is the object of the present invention to obviate.

According to Messrs. Siemens and Halske's arrangement, the alternate current generator is made to communicate by means of separate leads with each of the induction apparatus of the several branch stations, the generator being by preference arranged as centrally as possible relatively to such stations, so that each induction apparatus receives an independent supply of electric energy from the generator through conductors having all practically a uniform resistance, the induction apparatus supplying in their turn an induced

current of proportionate energy to the lamps or other apparatus on its branch circuit. If with this arrangement the consumption of electrical energy were constant and equal in all the branch circuits, as is the consumption due to resistance in the conductors, it would follow that the tension at each induction apparatus, and consequently at each lamp of each circuit, would also be equal and constant; and if a uniform increase or decrease in the number of lamps in action took place simultaneously in each branch circuit, the uniform tension in all the induction apparatus and consequently in all the lamps might always be maintained by simply regulating the production of electrical energy at the central generator. But in practice it will generally happen that the number of lamps in action in one or more of the branch circuits will differ from the number in action in the other circuits, and it may happen even that all the lamps in one or more of the circuits are entirely out of action, while those in the other circuits are all in action.

In this case it would be required for effecting a proper regulation, that the electromotive force of the central generator should be made to differ in a corresponding manner for each branch circuit in order to maintain at each one the normal difference of tension notwithstanding the variation in the consumption, but as this would be impossible when a single central generator (or a group of generators coupled in parallel arc) is employed, the following means are adopted for effecting the required regulation of tension in such cases:—The like named poles of the inducing coils of all the induction apparatus at the several branch circuits are all connected together by a so-called "equalising conductor;" that is to say, there is a conducting wire connecting all the plus-minus poles and a second such conducting wire connecting all the minus-plus poles. By this means the increased difference of tension which would occur in the induction apparatus of any one branch circuit in which for the time being a smaller number of lamps were in action than in the other circuits, resulting in the flow of too strong an electric current towards such induction apparatus, would be equalised by causing the excess of current so supplied to pass through the distributing conductors to the several other induction apparatus, and thus the tension at such circuit would be maintained equal to that of the other circuits.

As the equalising conductors might require to be of considerable size in order to provide for the equalisation of all possible fluctuations of consumption, and might consequently entail considerable expense where a large number of branch circuits existed at considerable distances apart, it is preferred, for the sake of economy, to provide only for the equalisation of the normal fluctuations within moderate limits by means of the equalising conductors, and to provide other means of regulation for extraordinary cases of fluctuation. Thus, according to one arrangement for this purpose, the leads from the central generator to the induction apparatus are so arranged that on a considerable decrease in consumption of electrical energy in any one circuit taking place, the contact either of one or of both the leads from the generator to its induction apparatus are broken, whereby, in the one case, the resistance of the supply circuit would be greatly increased, thus producing an equalising effect, while in the other case, the induction apparatus would only receive its current through the equalising conductors.

According to another arrangement, the regulation for extraordinary fluctuations may be effected by the inclusion or exclusion of special resistances in the supply circuit, and this arrangement may be employed in combination with that previously described.

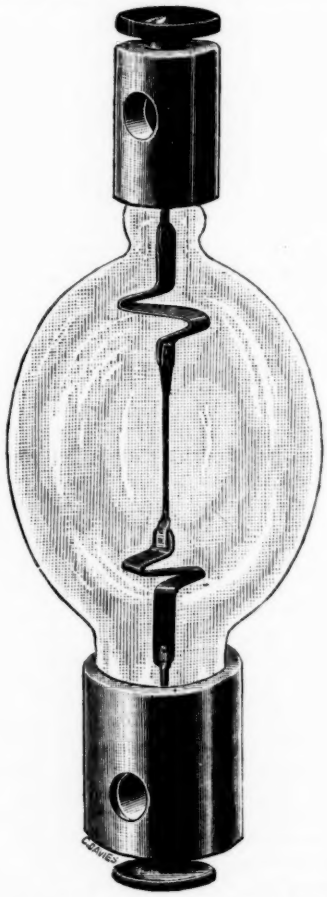
By means of the equalising conductors and by the disconnection of one or both of the leads, only the tension-difference at the terminals of the inducing coils of the apparatus can be maintained constant. As, however, the proportion between the electrical energy consumed by a branch circuit and that consumed by its induction apparatus will vary somewhat, according as the apparatus has to supply many or few lamps, it will be evident that with a constant tension-difference at the terminals of the apparatus, the tension at the lamps will nevertheless vary somewhat. In order, therefore, to maintain this latter tension constant, the tension at the induction apparatus must be rendered capable of a certain amount of variation, and this variation will be effected by the resistances to be included in or excluded from the supply circuit, so that such resistances effect as it were the more delicate regulation of the tension-differences, while the general or gross regulation is effected by the equalising conductors and, if necessary, by the breaking or making of contacts in the supply circuits.

In order to provide means for ascertaining at all times at the central station the state of tension at the lamps of each branch circuit a special conductor of thin wire is provided leading from the lamp circuit of each branch station to an indicating apparatus at the central station.

The fig. represents an arrangement of the system suitable for four sets of inductors, I, II, III, IV, each with its group of lamps, *a*, *b* representing the inducing and *c* the induced coils of each of the four inductors. The $\pm$ pole of each inducing coil is connected by equalising conductors with the $\mp$ pole of each of the others. If it be assumed that the lamps of the groups, I, II and IV are in normal work while only a few or none of the group III are in action, then the excess of current passing to III becomes distributed to the other inductors, thus effecting approximate equalisation as has been explained.

THE BERNSTEIN GLOW LAMP.

THIS lamp is shown in the illustration, which we reproduce from *Engineering*. The carbon conductor is



very substantial, far too much so to be called a filament, and is held between clamps connected to broad copper strips which are bent into zig-zag form to give

the fullest freedom to the dilatation of the glowing rod. The globe has at each end an insulated brass cap with a hole in the side of which the external insulated conductor is inserted, and secured by a binding screw. The lamp gives 35 candle-power with a current of 10 ampères and an electromotive force of 10 volts.

We have so recently described the switch and cut-out used in connection with this system of lighting that it is unnecessary to do more than allude to it. An installation can be seen in operation on the premises of the Bernstein Company, Commercial Road, Buckingham Palace Road, S.W.

NOTES.

The Loeb Chemical Electric Light Company, Limited.—With a view to united action, creditors are requested to send their names at once to Mr. H. Alabaster, the ELECTRICAL REVIEW Office, 22, Paternoster Row.

Electric Lighting in the Royal Navy.—On Friday, the 28th ult., the official trial of the electric light installation on board H.M.S. *Severn* took place at Chatham Dockyard, and proved entirely successful. The dynamos were Goolden-Trotter A type, one of 200 ampères, driven by a Willan's central-valve two cylinder engine at 400 revolutions, and another of 100 ampères driven by a Willan's three cylinder tandem engine, also at 400 revolutions. The installation consisted of 171 Swan lamps of 16 candle-power, 80 volts, and two Latimer Clark, Muirhead & Co.'s projectors, each running a search light of 100 ampères. The installation was fitted up by the firm of Goolden and Trotter, of Westminster, the entire work having been carried out by their own staff.

The Halifax Town Council and Electric Lighting.—The gas works extension Special Committee of the Halifax Town Council brought the following resolution, which it had previously passed, before the Town Council last week:—"That this committee recommend the Council to grant reasonable facilities to any electric light company which may be willing to put down plant for lighting any portion of the borough with electric light." The Mayor, as chairman of the committee, proposed the adoption of the recommendation, and Councillor Davis seconded it. The resolution was carried.

Electric Lighting and the Gas Companies.—A paragraph in the report of the directors of the Gas Light and Coke Company, just issued, says: "A period of great commercial dulness and depression, coupled almost to the close of the year with warm and bright autumn weather, has tended to check the usual increase in the private consumption of gas." We would like to enquire whether the extension of electric lighting in some part of the company's district has not also had some slight effect in checking "the usual increase in private consumption of gas."

Electric Lighting Abroad.—The Société Industrielle has received an order for a portable electric plant, for Egypt, with portable masts, specially intended for *fêtes*. The Place St. Lambert, at Liege, is to be lighted by five arcs of 1,500 C.P. The contract for this has been given to the Société Anonyme Electricité et Hydraulique, of Charleroi, at £659 for the erection of the plant, and 6s. 5½d. per day for lighting. The workshops of M. Bollinckx, at Brussels, are to be shortly lighted by means of a mixed arc and incandescent system. At a large hat factory at Cureghem, where a considerable amount has been paid for gas lighting, it is intended to instal the electric light in the various rooms, a considerable economy being expected to result.

The Electric Light at the Cardiff College.—Twenty incandescent lamps of 20 C.P. each, fed by 21 secondary cells, which have been supplied by the Elwell-Parker Company, are now being fixed. A Tangye gas engine is employed during the day to charge the secondary battery with sufficient energy to light the lamps for eight hours.

Electric Lighting of the Small Pox Hospital Ships at Darenth.—The lighting of these vessels, which was undertaken some 15 months ago, is, we understand, still in successful operation, the dynamos being located on shore some 100 yards from the ships. The current from the dynamos is conveyed to a switch-board on the centre ship—there are three of them—by means of four cables, consisting of 19 No. 11 copper wires, insulated and sheathed with 18 No. 4 iron wires, and thence by smaller cables to the two other ships moored ahead and astern of the centre ship respectively. These cables were manufactured and supplied by Messrs. Callender's Telegraph Company, and were laid from an ordinary sailing barge. We are not aware of any other conductors of this size having yet been successfully laid under water, and the result speaks highly for the insulating properties of vulcanised bitumen.

The Telephone on Mount St. Bernard.—The monks of St. Bernard, who devote themselves as ardently to the study of science as to the rescue of wayfaring men, have brought the telephone into their service of mercy. The famous hospice is now in telephonic communication with the Cantine de Proz and the village of St. Pierre, as also with the Cantine de Fontinte and the village of St. Chemy, on the Italian side. A further extension of the system is in progress, though the execution of it must needs be surrounded with great difficulties in that Alpine region of snow and ice.

The Telephone in Berlin.—The telephone wires are daily increasing in number and length over and around the Prussian capital. The total length of the wires is, in round numbers, 12,000 kilometres, or very nearly the diameter of the earth. There are nine exchange offices in the city, and 10,000 speaking-tubes. The number of subscribers in Berlin is about 6,000, who hold an average of 100,000 conversations daily, In the neighbourhood the number of conversations averages daily between 1,500 and 2,000. The Berlin telephone system employs 300 officials. The furthest point with which Berlin is directly connected is Hanover, distant 340 kilometres, or about 215 miles.

Telephone Wires at Dover.—At the last meeting of the Dover Managing Committee an application was received from the telephone company asking for permission to erect a telephone pole at the corner of St. Martin's Terrace. A further application was received from the same company for permission to attach two wires temporarily to the Town Hall. The surveyor said the application was made on the understanding that the company would remove the wires on the council giving permission to erect the pole at St. Martin's Terrace. It was proposed to attach the two wires to the pole at the Town Hall Tower. Alderman Fry said he looked upon the telephone as one of the greatest advantages they had ever had in Dover. If they delayed giving their permission it meant the cutting of two wires. Alderman Marshall said he could not see why the Town Hall should be used for the business of the telephone company. Councillor Clark said the Town Hall belonged to the people, and he did not see why permission should not be given when it was for the convenience of the public. He would move that permission be given to the company. Councillor Lukey seconded. The surveyor said the company would guarantee that no damage should be done to the building. An amendment was then moved that the matter stand over for a week, but on its being put to the meeting it was lost.

Telephone Experiments in Germany.—The Imperial Post Office of Germany is making extensive experiments with telephones. All places in the Grand Duchy of Hesse have just been telephonically connected, and should the experiment succeed the arrangement will be extended to the whole of Germany.

The Underground Telegraph Wires.—The question of connecting some of the chief towns in the United Kingdom by underground telegraph lines is being considered by the Post Office.

French Atlantic Cable.—We read in the *Revue Economique* that "M. Granet, in the exercise of the powers which are reserved to him in deeds of concession, has officially notified the French Atlantic Cable Company to withdraw from the syndicate of English trans-Atlantic cable companies. The separation has taken place to-day" (February 5th). "It is too early as yet to foresee the consequences of this new condition of affairs. We, therefore, confine ourselves to recording the fact, and add that M. Pouyer-Quertier, who, in his position as president of the original council, signed the agreement with the English syndicate, must necessarily retire from the office of president of the new council."

Telegraph Communications in France.—During the debate in the French Chamber of Deputies on the Telegraph Budget for 1887, it was stated that business men in Paris were at a great disadvantage compared with London merchants with regard to telegrams from the East. It seems that a message from Alexandria to Marseilles occupies 7 minutes, and from the latter place to London, a special line takes the message in 18 minutes, or a total between Alexandria and London of 25 minutes. Messages to Paris are, however, treated differently, for at Marseilles they have to take their turn with the rest of the traffic, the average time occupied in transit being 80 minutes, or a total of 87 minutes between Alexandria and Paris. The communication between Havre and Paris also leaves much to be desired, for the time occupied in transmitting a message between these places is 90 minutes, whereas between Havre and Hamburg the average time is 35 minutes. Another point to which attention was called is the poor service between the important parts of Havre and Liverpool, there being no direct wire, a stipulation to this effect having been made in the contract entered into with the Submarine Telegraph Company. When rapid communication is necessary, telegrams between Havre and Liverpool are actually sent *viâ* New York, the transmission over this route taking less than an hour, while *viâ* the Submarine Company's cables two hours are occupied. The Minister of Posts and Telegraphs in reply, stated that it was the intention of his Government, upon the renewal of the contract with the Submarine or any other company, or with the English Government, to insist, as a condition of contract, upon the establishment of a direct line between the ports above mentioned.

Underground Telegraphs.—At the annual meeting of the Associated Chambers of Commerce of the United Kingdom on Tuesday, Mr. Linley Watson (south of Scotland) moved:—"That in consequence of the frequent interruption of telegraphic communication by storms, the Government be requested to take steps to have the principal lines of wires conveyed under ground." He explained that it was only intended to apply to the great telegraphic lines of communication which, in the interests of the country, it was so necessary to maintain uninterrupted, and he referred to the serious wreckage of wires last month which had paralysed the commercial world, and said that such breakdowns would occur again and again until aerial wires were abandoned, and the main lines were placed underground. The resolution was agreed to, and it was determined that a representation should be made to the Government.

Submarine Telegraphy.—In the House of Commons on Monday, Mr. Raikes said that the concession held by the submarine Telegraph Company from the French and Belgian Governments would cease in 1889. The question as to how far it was desirable that telegraphic messages between England and France should be conveyed through the medium of a private company was engaging his attention.

Fire in a Telegraph Works.—Last week a corrugated iron and timber building of one floor, occupying a space of some 60 feet by 30 feet, in Green Lane, North Woolwich, and owned and occupied by Henley's Telegraph Company, was entirely destroyed by fire.

Telegraphic Communication with Morocco.—The *Globe* correspondent at Tangiers writing this week, says:—"A few days ago the steamer *Electra* was observed moving about in Tangiers Bay early in the morning, and it speedily oozed out that preparations were being made to connect the Eastern telegraph cable with this port. It is a fact that for nearly ten years the telegraph company's efforts have been baffled, partly by Moorish obstruction and partly by the jealousies of some of the foreign representatives, who by no means desired to see any augmentation of British influence in this part of the world. The fact that the cable was actually being laid called forth, as may be imagined, strong remonstrances from the Moorish authorities addressed to Mr. Kirby Green, our Minister Plenipotentiary, and rumours were heard of further delays and indefinite postponement. Any doubts on the subject, however, were speedily dispelled. The English Minister returned an answer to the effect that some weeks ago he had secured the concession from his Shereefian Majesty, and of course his Excellency was not responsible for any delay which might have occurred on the part of the native Government in sending due notification to the local authorities in Tangiers. In fact, the affair was 'all right.' Thus was brought to a successful issue a contention of many years, and that for the first time this Empire has been placed in direct communication with Europe, is due to a combination of tact, energy, and decision which has been displayed by Mr. Green, who, it must be remembered, has been only in a position to bring to his aid moral suasion in order to combat the hereditary policy of exclusion hitherto so successfully practised in Morocco."

Telegraphic communication, we are informed by the Direct Spanish Telegraph Company, has been opened with Tangiers (Morocco), the rate being 7d. per word.

Presentation to a Canadian Telegraph Official.—On Christmas Eve the *employés* of the telegraph service at Battleford, Saskatchewan, waited upon Mr. Hartley Gisborne, the district superintendent, and presented him with an address and a rich silver tobacco-box, as a slight acknowledgment of their appreciation of his conduct and capabilities.

King's College.—The twenty-seventh annual dinner of the Old Students of King's College, was held at the Holborn Restaurant on Friday evening last, the chair being taken by Sir Edward Clarke, Q.C., M.P. Amongst those present were Prof. Hughes, F.R.S., and Mr. W. H. Preece, F.R.S.

One Hundred Years Hence.—On the 1st of April, in the year 1987, a remarkable youth will be born. He will study physical geography and telegraphy, and will find, what every schoolboy knows, that in going round the world a day is gained or lost as the case may be. He will then send himself round many times by telegraph and found himself in the Middle Ages. He could not get back, as the telegraph was not then invented, so to drown a small sorrow in a greater he married and became his own remote ancestor.

A Proposed New Company.—We hear it rumoured that a new venture styled the British Magneto-Electric Bell and Signal Company is in course of formation with a capital of £100,000 in shares of £1 each. It will acquire the rights and benefits of an agreement with the *Compagnie de Signaux Magnétique et Communication Telephonique*, for the immediate commercial development throughout the United Kingdom, &c., of a remarkable invention which offers facilities not hitherto possessed by the public for electrical communication by signal codes, bells, or indicators over long or short distances. We believe the remarkable invention is nothing more nor less than an improved magneto-bell pull of the Abdank Abakanowicz type, which our readers can find fully described and illustrated in the REVIEW for August 18th, 1883, the improvement consisting in the addition of a second magnet.

Electric Lighting Risks.—We would call attention to the letter of Mr. Musgrave Heaphy, C.E., in our correspondence columns and, at the same time, ask if any of our correspondents can inform us whether the recent large fire which took place on the premises of Messrs. Lewis, of Liverpool, was occasioned by electricity.

Underground Lines.—We had an opportunity last week of examining an experimental underground line, laid at the Callender Company's works at Belvedere, which looks promising for underground telegraphy. The company has been experimenting for some time past with the view of overcoming the retardation on wires buried in the earth, which with the present system is an effectual bar to rapid working and to the use of multiplex instruments. In a future issue we hope to be able to publish particulars of the tests recently taken, and, in the meantime, we can say that the inductive capacity of the conductors was alleged to be reduced to one-half the normal figure for such a line laid in the usual manner. Anyone who has charge of a telegraph line knows that the difficulties inherent to underground work arising from increased inductive capacity, retardation, and small area of conductor are a much more effectual obstacle to the placing of our wires underground than the mere question of expense, serious though it be. If anything is to be done in this direction by the G.P.O., as now appears probable, some system giving facilities for speed far in excess of the pipe lines must be adopted. It appears to us that the Callender Company has at least gone some way towards solving this problem.

A Chance for Electricity.—The *Sussex Daily News* says :—"The Petworth Gas Company is about one of the sweetest little local things in the county, and those who are lucky enough to hold shares may well feel delighted to possess them, and pocket their 9⅞ per cent. The company has been paying this for some time past, but it may be imagined the jubilation of these 'fortunates' would not be quite so great if the electric light were brought nearer Petworth. 'But no such luck!' 4s. 7d. per thousand cubic feet for a few more years yet!"

Railway Signalling.—The control of the starting signals from the station in advance has been for a long time under consideration on the Metropolitan Railway, but some difficulties which were experienced have now been overcome, and it is thought that the electric locking of all the starting signals will be completed by the end of March.

The Isle of May Lighthouse.—The master of the Swedish steamer *Frithsof* reports, in a private letter, that he observed in the sky a reflection of the light on the Isle of May at a distance of 46 miles from the island. It will be remembered that the Isle of May is lighted by electricity, two large De Meritens machines being used, developing, it is calculated, a total candle-power of 60,000.

Central Stations.—The central electric lighting station at Nice is the subject of an article in the *Bulletin International de l'Electricité*. That journal points out that Nice is, or ought to be, a favourable field for the electric light, since the cost is, in the local circumstances, a subordinate matter; but seeing that the electricians are about to attempt to compete with gas in the item of price, the *Bulletin* fears that this enterprise, like all others entering on the same fatal path, is predestined to ruin.

Extension of the Electric Lighting at Leathersellers' Hall.—The installation of the electric light at the hall of the Leathersellers' Company in St. Helen's Place is being much extended and improved. In addition to the 200 incandescent lamps, which were already fixed in the hall, the remaining portions of the company's buildings are being fitted with wires for 62 lamps. Storage cells of the latest type are being fixed, which will be sufficient to supply the current for 100 20-candle-power lamps. Several improvements are being introduced with respect to the insulation of the cells, so as to prevent leakage, and a specially-improved switchboard has been fitted up for regulating the supply of the current. The installation is being carried out by the Electrical Power Storage Company.

Bollmann's Dynamo.—Since its first appearance, some two years ago, this dynamo has been greatly improved, the manufacture having been undertaken by Messrs. Egger and Company, of Vienna. The latest machine turned out is constructed for 1,500 lamps of 16 C.P., and gives 100 volts at 750 revolutions, the total output being 100,000 watts. The total weight of the machine is 3 tons 12 cwt., which is at the rate of a little over ½ cwt. per 1 H.P. output. This satisfactory result is obtained partly by the high speed and partly by allowing the very large current density of 4,600 ampères per square inch of the armature conductor. The armature is of the disc pattern, contains no iron, and in arrangement resembles somewhat the well-known Ferranti machine; but the winding is somewhat more complicated.

Dynamo Construction.—Mr. B. Cabella writing to us from Milan says :—"We see in the number for January 28th, p. 86, that the Berlin Edison Company has adopted a form of dynamo with the yoke in the bed plate and the armature above, similar in arrangement to the machines made now by Gramme, Kapp, Siemens, &c., and in the preceding number of the Journal that Siemens Bros., for the lighting at Olympia, have adopted an altogether similar form of machine. Now, with your permission we will make an observation. This type of machine which seems to enjoy a certain reputation, was patented in France by Gramme on March 17th, 1885. It appeared in the announcements in your Journal in December, 1885. The firm of Siemens of Berlin gave it as a novelty in the first number of the *Electrotechnische Zeitscrift*, 1886. Nevertheless, we constructed it several years before, in 1883, and we published it with drawings in the number for January 25th, 1885, of the journal *Il Giorno Rivista d'Elettricita*, which is published at Milan. We send you a copy of the number in question, in which at p. 57 you will find the drawing. We also send you the number for February 28th, 1886, in which on p. 139 you will find notices and drawings relating to the question. In No. 1, 1887, of the journal *l'Industria*, of Milan, you will find further notices. The type, which, we believe, we were the first to design and construct—because we find nothing similar in the electrotechnical publications—is, as we wrote to M. Gramme, when he asked us whether we had taken out a patent in France, handsome, convenient, rational. The fact that all the principal dynamo manufacturers are appropriating this form confirms the declarations made on behalf of M. Gramme by M. Fontaine, and show what good reasons we had for establishing it. If you will give some attention to this history you will much oblige."

Electric Transmission of Energy.—A small installation for distributing 10 H.P. is now in successful use at the Gare de l'Est in Paris. A compound wound 10 H.P. dynamo is generating the current, which is delivered to seven small motors, each working one of the tools in the repairing workshops. To provide for changes of speed, each motor is fitted with a resistance box and rheostat. The whole installation has been put up by the Compagnie Electrique, and works with complete suceess ; the dynamo and three of the motors having already been running for five months, without having cost a penny for repairs.

The Detection of Gas Leakage.—The electric apparatus invented by M. Arnould for the indication of an escape of gas is now coming into use. It consists of a copper cylinder containing a bichromate cell, the current being passed through a small platinum wire, raising it to a dull red heat. If in the apartment where the apparatus is introduced there is any gas mixed with the air, the platinum wire immediately becomes brighter, thus indicating the presence of an explosive mixture. The apparatus is exceedingly sensitive, showing even a small leakage.

A New Switch.—We have received from Messrs. Rose & Co., of Bradford, one of their patent switches, which, as it appears to possess some features of interest, we shall describe and illustrate in our next issue.

Berly's Universal Electrical Directory.—The sixth annual issue of this book of reference is now published, a delay having been caused by the illness of Mr. Berly, who, as in former volumes, contributes "Remarks on the Past Year." The directory is as carefully compiled as usual, and, while it increases in size, its accuracy makes progress likewise.

The Sale at the Indian and Colonial Exhibition.—Last week we gave the average price brought by the sale of cable at the Indian and Colonial Exhibition as £45 per ton. Messrs. Wheatley Kirk, Price and Goulty now inform us that they find, on taking the total weights and values together (the weight of the insulation being included), that the average price realised was £83 per ton.

Incandescent Lamps in Parallel.—Is there any truth in the rumour which we hear, that the Anglo-American Brush Corporation claims that one of the Lane-Fox patents which the Corporation holds gives it the sole control over parallel incandescent lighting, and that this control will shortly be exercised? It might be advisable to look up a patent granted to the late R. Werdermann in 1878, prior, we think, to that of Lane-Fox.

Sir Charles Bright's Address.—We have received a letter from Mr. F. H. Varley referring to the communication from Sir Charles Bright, which appeared in our last issue. Mr. Varley deals mainly with the relations which his late brother Cromwell had with the Electric Telegraph Company. He sends us also an excerpt from the minutes of the proceedings of the Institution of Civil Engineers, session 1883-84, but as the matter came to hand too late for this week, we are compelled to leave it over.

All Night Communication.—It has been decided to keep open the telephone exchanges at Plymouth and Mutley, day and night (Sundays excepted) until the close of the present year. This course has, however, been adopted merely as an experiment, and will not be continued after the time mentioned, unless the company consider that the extra measure of support accorded to them in consequence justifies them in incurring the expense. At present the subscribers number 155, and the membership roll will have to be increased to 200 if the benefits of a nocturnal service are to be permanently secured.

The Welsbach Incandescent Light.—The new gas burner invented by Dr. Carl Auer von Welsbach, of Vienna, which was described and illustrated in our issue of January 7th, is being introduced to the British public by the Welsbach Incandescent Light Company, Limited. On Tuesday evening last week representatives of the Press and others were invited to witness the illumination by this system of the Marlborough Gallery of Pictures, No. 53, Pall Mall (Mr. Colnaghi's). A central gas pipe is run from end to end of the gallery from which 56 brackets support as many Welsbach lamps. The average consumption of gas in each burner was shown to be about 2 feet per hour at a pressure of $\frac{9}{10}$ of an inch, and the average illuminating power was calculated to be about 17 candles, showing an efficiency of about $8\frac{1}{2}$ candles per cubic foot of gas consumed. The light was perfectly pure, steady and brilliant, absolutely smokeless, and giving off far less heat than ordinary gas burners. While the consumption of gas is greatly reduced, the cost of the special burners, which can be screwed on to ordinary gas fittings, is stated to be a mere trifle, and the prepared cowls or hoods, which last from 800 to 2,000 hours, according to situation, are renewable at a small cost.

The "Great Eastern."—A circular has been distributed advertising the sale by public auction, on February 17th, in Liverpool, of this ill-fated vessel. We are informed that during her employment as an exhibition ship at Liverpool a handsome profit was realised, the receipts amounting to upwards of £29,000. She is stated to be in thorough repair, and perfectly seaworthy, but no mention is made of the speed she is expected to attain. We understand that in her last trip to Dublin, where she is now lying, her steaming power was considerably lower than anticipated.

The Telegraph in the "North West."—The Government Telegraph Service has completed a line from Edmonton to Saddle Lake Creek, a distance of 110 miles, touching at Fort Saskatchewan and Victoria; the poles are of tamarac (*larix americana*), 20 feet long and 5 inches in diameter at the smaller end, erected 60 yards apart, while porcelain insulators, weighing 20 ozs. each, and oak brackets (screw) are used; the wire is No. 6, weighing 570 lbs. to the mile. This line will be continued on to Fort Pitt next season, a distance of 98 miles, to connect with the east *via* Battleford. The line between Battleford and Fort Pitt (89 miles) is the first line in Canada in which iron poles are used; it was erected in 1886. The iron poles weigh about 47 lbs. complete, are 16 feet long, $2\frac{1}{2}$ inches in diameter at their larger end, are sunk three feet in the ground, and have not moved the $\frac{1}{16}$th of an inch since erected, although No. 6 wire is used. The iron poles are placed 55 yards apart. This district, of which Mr. Hartley Gisborne is superintendent, has 1,177 miles of line.

Indian Telegraphs.—The adminstration report of the Indian telegraph department for the year 1885-86 shows that the work done during the past year is highly satisfactory, as regards both the increase of business and the extension of the telegraph system itself. In the course of the last three years the length of lines has been increased by 17·9 per cent., and the number of offices by 27·7 per cent.; while the revenue has risen by 23 per cent., and the working expenses have diminished by 3·4 per cent. The opening of offices worked by extra departmental agency, and the system of deferred messages, which now form no less than 63·15 per cent. of the total traffic, have largely contributed to the efficiency of the department. The progress made since the introduction of these changes has been such that the number of departmental offices has been nearly doubled, and the gross revenue has risen from Rs.38,54,212 in 1881-2 to Rs.51,10,986 in the last year, the charges against revenue account increasing from Rs.32,35,644 to no more than Rs.36,18,695. The capital expenditure in 1885-86 was Rs.3,83,16,760, of which Rs.29,36,842 was expended during the year. The net

revenue, Rs.14,92,291, represents a return of 4·05 per cent. on the total capital outlay to the beginning of the year, plus half the capital outlay during the year. The report also notices the exceptionally arduous character of the special works undertaken during the year, and the remarkable as well as hazardous work performed in Upper Burmah, where 244 miles of line have been renewed, and 159 miles of new line have been constructed. In conclusion, the Governor-General in council notes these results with great satisfaction, and compliments Mr. Cappel, the Director-General of Telegraphs, for the third time, we believe, in the last twelve months, on his able management of his energetic and hard-working department.

Registration of Telegraphic Addresses.—At the meeting of the Associated Chambers of Commerce, Mr. Pim (Dublin) moved that the charge of one guinea per annum for the registration of telegraphic addresses was excessive, that it be reduced to 5s., and that the Executive Council be requested to address the Postmaster-General with a view to that reduction. This was seconded by a delegate, who said that it was not imagined that the charge of a guinea was to be an annual one, and he knew in one town that 30 per cent. was not renewed, while in other cases where nothing was known about the necessity for renewal, telegrams with the shortened address were returned as insufficiently addressed. The chairman thought that some difference should be made between London and provincial towns, and suggested postponing the resolution for the purpose of re-drafting at the end of the meeting. This suggestion was adopted.

Telegraph and Telephone Wires.—Mr. R. Cooper-Willis, writing from Lincoln's Inn Fields to *Engineering*, says:—"There seems at the present time much halting between the two opinions as to whether the public shall see telegraph wires 'skied,' *i.e.*, hung up high upon posts in the air, or whether these same wires shall be kept warm and dry underground, and that the public shall not see them at all. So far as the point of expedience goes it is absolutely necessary that these wires should exist, but the point is where to put them. The wires of cities and towns of the United States of America do not suffer from the troubles of storms nearly as much as we do with our complicated arrangements in England. In Chicago, New York, New Orleans, and Philadelphia (a few are underground) the majority of the wires, both telegraph and telephone, are either put upon iron posts well sunk in the ground at a height of 20 feet or 25 feet, and at spans of 40 or 50 yards. The points at which any difficulty arises is at the street crossings. There the posts are heightened so as to allow the passage of high vehicles or carts. This system (which from information I only know) seems a course of disposing of the wires at a height, not too high to be subject to the wind, or to be dangerous as a nuisance to the passengers in case of breakage. The small span also reduces the chances of breakage to a minimum. A system of this kind, perhaps a little costly at first to lay down, would be but a drop in the ocean in comparison to the £3,000,000 estimated to put these wires under ground. To sum up the total benefits to the public, to the Government, and the private telegraph and telephone companies, would be:—1. Less danger to the public. 2. Greater accessibility to the wires for repairs and putting up. Therefore less danger to the workman and less expense to the companies. These benefits seem to suggest to any thinking person that they are paramount to the highly sentimental grievance which is sometimes urged as to dissymmetry of our fine streets by the imposition of telegraph poles along the curbstones of pathways, and if this system which is found to work so well in the towns and cities whose average areas contain as great a population as the great City of London, it seems to argue a great lack of ordinary reason in the minds of those whose duty it is to cut down expenditure and remedy defects which at present exist in this branch of our great commercial enterprises."

Telegraph Clerks and the Royal Commission.—The annual meeting of the Bradford Postal Telegraph Clerks' Association was held last week. The chairman said the work performed by telegraph clerks was of as much importance to the public as that of any other department of the Civil Service, yet they were in a much worse position than other Government clerks. They had to do Sunday duty without pay, and the prospects of promotion in the department were so small that few of them could ever hope to rise beyond the classes in which they were at present. He regretted the Postmaster-General's refusal to furnish the statistical information which was essential for the claims they desired to place before the Royal Commission, and a resolution was passed to this latter effect, and expressing the hope that the Postmaster-General would shortly see fit to grant the information required.

Electrical Phenomena on a Mountain.—Writing to *Science*, M. John Le Conte says:—"In confirmation of the observations of 'M. F.' in relation to electrical phenomena on Lone Mountain, near Bozeman, I beg leave to call attention to the fact that more than twelve years ago Mr. Franklin Rhoda, assistant topographer, in his 'Report on the topography of the San Juan country' (*vide* F. V. Hayden's 'Report of U.S. geological and geographical survey of the territories for the year 1874,' pp. 456–458, also p. 461), gives a detailed and graphic account of similar electrical manifestations experienced by Mr. A. D. Wilson and himself at station No. 12, on one of the peaks of the San Juan Mountains, in August, 1874, at an altitude of 13,967 feet above the level of the sea. An interesting and significant circumstance recorded by Mr. Rhoda was the fact that there was a sudden and instantaneous cessation of the distressing electrical manifestations whenever a stroke of lightning took place, to be speedily renewed by the returning tension of the electricity. He says, 'The sharp points of the hundred stones about us each emitted a continuous sound, while the instrument outsang every thing else, and, even at this high elevation, could be heard distinctly at the distance of 50 yards. The points of the angular stones being of different degrees of sharpness, each produced a sound peculiar to itself. The general effect of all was as if a heavy breeze were blowing across the mountain. The air was quite still, so that the wind could have played no part in this strange natural concert, nor was the intervention of a mythological Orpheus necessary to give to these trachytic stones a voice.'"

Lighthouse Illuminants.—A Blue book has been published containing further correspondence on the subject of lighthouse illuminants. The 117 letters contained in the book have dates ranging from January 22nd, 1885, to November 30th, 1886; and include the correspondence between Mr. Wigham, the Board of Trade, the Trinity House, the Commissioner of Irish Lights, and other bodies concerned in the maintenance of lighthouses.

Telegraph Cables and Meteorology.—*Nature* expresses the belief that any money which might be spent in federating the West Indies meteorologically by means of the telegraph, even if new cables had to be laid here and there, would be saved over and over again in 20 years by the protection afforded to shipping by forecasts during the hurricane season, and observes: "Supposing such a system as this at work in one of the most interesting regions of the world from a meteorological point of view, and controlled, if need be, from the Mother Country, represented by the Meteorological Council, good would come all round; the Meteorological Council would gain a larger and closer view of the phenomena which it is its duty to study, and the federated Colonies would obviously gain by the reduction in the yearly loss of life and capital."

NEW COMPANIES REGISTERED.

Carlyle-Elmore Limited.—Object: To acquire the business of William Alexander Carlyle, manufacturer of electro-dynamo machines, electrolytic engineer's supplies, electro-platers and polisher's plant and supplies, and also electro-platers and polishers, carried on at the Dynamo Works, Nos. 91, 92 and 101, Constitution Hill, Birmingham. Signatories (with one share each), *W. A. Carlyle, George Bennett, J. F. H. Cartland, J. H. Cartland, A. H. Foster, J. Cooper, all of Birmingham, and *William Elmore, of 359, Clapham Road, London. The capital of the company is £10,000 divided into 4,000 A or £5 per cent. preference shares and 6,000 deferred shares of £1 each. The signatories denoted by an asterisk are the first directors; remuneration £5 to each director for every board meeting attended. Registered office, 78, 80 and 82, Constitution Hill, Birmingham. Registered 2nd inst. by R. Jordan, law stationer, of 120, Chancery Lane.

New Portable Electric Lamp and Power Syndicate Company, Limited.—Capital, £9,000 in £200 shares. Objects: To carry out an agreement of December 30th between Benjamin Nicholson and a trustee for the company, for the purchase of certain patent rights referred to therein: to produce and supply electricity or electrical currents or force, and in connection therewith to produce and supply light, heat, motive power, telegraphic, telephonic, and other means of communication. Signatories (with one share each), George Marquis de Stacpoole, Mount Hazel, Galway; F. H. Sumner, Chertsey; B. Nicholson, 41, Coleman Street; D. Parrish, Bromley, Kent; N. Story Maskelyne, M.P., Swindon; H. Hoare, 5, Moorgate Street; J. H. Jackson, M.P., Bexley. Directing qualification, one share upon which all calls have been paid. The signatories are to appoint the first directors. Remuneration, £100 per annum, and in addition thereto 15 per cent. of the annual net profits remaining over after payment of 10 per cent. dividend upon the share capital. Registered 2nd inst. by Paine, Son and Pollock, 14, St. Helen's Place.

International News Association, Limited.—Capital £30,000 in £1 shares. Objects: To purchase the letters patent, No. 9,230, dated 20th June, 1884, granted to Charles John Chubb for improved methods of combining the posting or publication of telegraphic or other news with advertisements; to make arrangements and enter into contract with telegraph companies, new agencies and others, for the receipt and publication of telegraphic or other news. Signatories (with one share each):—J. Slade, 27, Clements Lane; H. M. Collins, 177, New Road, Rotherhithe; Capt. G. E. Joseph, R.A., Rutland House, Aberdeen Park, Highbury, N.; R. S. Hazlon, 115, Cannon Street; L. Gunter Claremont, Norwood; C. W. Turner, Trinity Road, Wandsworth Common; W. H. Phelps, 12, Hanover Street, Islington. The signatories are to appoint the first directors, qualification 250 shares; remuneration £500 per annum. Registered 3rd inst. by Slade and Munk, St. Clements House, Clements Lane, E.C.

Electrified Rooms Company, Limited.—Capital £525 in 21 shares of £25 each, with power to increase. Objects: To acquire the patent rights of Capt. Arthur Henry Byng, dated respectively the 25th February, 1886, and 31st May, 1886, granted for "Novel forms of applying electricity for therapeutic purposes," and for "A regulation for high tension electric currents." Also to purchase certain electric appliances belonging to the inventor now at 23, Landport Terrace, Southsea. Signatories (with one share each):—Lieut.-Colonel N. W. Wallon, Major P. L. Gordon, R. J. Rastrick and D. C. Wollsnorton, all of Southsea; A. W. White and A. Ford, of Portsmouth; J. R. Martyr, North End. Registered 8th inst., without special articles of association, by Messrs. Waterlow Brothers & Layton, Birchin Lane, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

W. T. Henley's Telegraph Works, Limited.—The annual return of this company made up to the 4th December, was filed on the 16th December. The nominal capital is £70,000 in £10 shares. The number of shares taken up is 6,005, upon which the full amount has been called. The calls paid amount to £60,320. Upon 90 shares forfeited the sum of £270 has been paid.

CITY NOTES, REPORTS, MEETINGS, &c.

Anglo-American Telegraph Company, Limited.

THE ordinary half-yearly general meeting of this company was held at Winchester House, Old Broad Street, on Friday last, under the presidency of the Right Hon. Viscount Monck.

Mr. T. H. Wells, the secretary, having read the notice convening the meeting,

The Chairman said: It is now my duty to move the adoption of the report, and in doing so let me frankly express to you my regret that we are not able to bring before you a more palatable bill of fare than we disclose in the report. I will not on the present occasion trouble you with any comparison of receipts for the past year; the change in the rate of carriage would make the comparison entirely illusory and useless. If you look at the accounts you will see that the difference between the expenditure this year and last year is very trifling—it is rather larger this year than last; but that is the result of our having to carry a larger traffic, about which I shall have something to say presently. During the last half-year we have had the misfortune to have a break in the St. Pierre cable, the old French cable, the oldest one we have in existence. The break has occurred in very deep water, and will involve a considerable operation in repair. At this time of the year it will be useless to attempt it, and therefore I shall not say any more about it, except that we shall use our best efforts to repair it, and I hope we may be successful. There came upon us at the end of the year—on December 31st.—like a thunderbolt, a notification from our partners, the French Atlantic Company, that they meant to terminate—not that they meant, but that they did then and there terminate—the agreement with us under which we have been working for several years past and under which they had derived a very great advantage beyond anything which they have brought into our pool. I confess our surprise at such a thing being done—it seemed to be so contrary to their own interests; but I believe they do not themselves deny it that this notice was served under the influence and to suit the purposes of the Commercial Cable Company. We believe that they have no right legally, by the laws of France or by the laws of England, to take the step they have taken. They assert that it is in consequence of pressure on the part of the Minister of Posts and Telegraphs in the French Government, but they had been working for years under this agreement, with the full assent and concurrence of the Minister of Posts and Telegraphs of France. For six years we have been working under this agreement with the full assent of the French Government, and therefore we cannot admit they have a right to turn round now and upset all the arrangements we have made with them; we are, therefore, at present taking the best legal steps we can to assert what we believe to be our rights, and to meet this attack, as I may call it, of the Commercial Company. That being the case, I had better not say much more about it, except to tell you the simple facts, because they are now in the hands of our legal advisers. I now come to what is really the crucial point of the day, and that is the competition which is still going on for the traffic to America. I would wish to recall your attention to the circumstances as they stood at our last general meeting. Previous to that meeting the Commercial Company had opened their cable for traffic. Their first step was to reduce the tariff from 2s. to 1s. 8d., that is to say, from 2s. to 2f.; the effect of that was simply reducing the rates without in any degree increasing the volume of business. We endeavoured to work for some time on that tariff, but we found it so disadvantageous (it is not necessary to go into other reasons now) that we were obliged to abandon it, and when we came to abandon that tariff we had to reconsider our whole policy. Hitherto on the opening of competition we had endeavoured by arrangements to maintain our tariff, hoping thereby to maintain our revenue; but we found that that mode of proceeding had really the effect of attracting further competition into the field. It is a most curious thing. It seems as if telegraphing across the Atlantic has some sort of fascination for capitalists. Although men saw that the companies already existing were making very small dividends, that the enterprise was a most risky one, and involved a very large outlay, they yet seemed by some extraordinary fascination to be attracted to put their capital further into the business and to create further competition, thereby largely injuring the existing companies without in the slightest degree benefiting themselves. We considered our whole position, and we came to the conclusion that the only policy we could adopt in the face of what was going on was a policy of going to a low rate with the view of stimulating the traffic—increasing the traffic so as to give us a moderate

dividend, which would not serve as an attraction to other people to enter into further competition. We, therefore, reduced our tariff to 6d. a word. When we came before you with that proposition I told you it was an entire reversal of the policy we had hitherto pursued, and I told you at the same time it was a policy which would make large demands upon your forbearance and patience. We have now been carrying out the 6d. per word tariff for something like nine months, and the result has been a very considerable increase in the volume of business transacted. Of course, when you think our reduction was really a reduction of three-fourths of the cost, it must take a considerable time, even if the time ever arrives when the loss caused by the reduction will be made by the increase of traffic, but we may hope that if trade improves, and things in general get better, that we shall participate in the improvement, and that our traffic at a low rate may become the normal price of traffic across the Atlantic. That is the object we have in view; that is the design we had in going to a low figure, and we must trust to your forbearance to allow us to give that principle a full trial, so as to see whether we can by reducing the cost of transmission stimulate and increase the traffic and the business across the Atlantic. We have been told that this has been adopted as a fighting tariff; it is no such thing. We do not want to force the other companies —our competing companies—into any arrangement with us, but we do want to establish such a traffic as will give us a fair return for our money, and not induce, by enlarged dividends, other persons to invest their money in Atlantic cables. We have arranged that after this half-year no further additions shall be made to the renewal fund. Well, that will give us at all events some dividend, because we have been earning, even under the disadvantages we have had during the past half year, what would be at least 1 or a little more than 1 per cent., and we hope to improve that because the traffic is increasing, and as it increases of course it will give us more. Under these circumstances I have to ask for your further forbearance and further trial of this plan and this principle so as to ascertain whether it is possible for us to fix the price of traffic across the Atlantic at a low rate, and maintain thereby a moderate dividend, and offer no attraction for further competition. I beg to move the adoption of the report.

Mr. William Abbott said he came there that day with certain theories in his mind which he intended to expound, and perhaps the wisest course would have been to wait till he had heard some other speakers in order that the force of the remarks the chairman had made might evaporate, for he (the chairman) had always a persuasive way in urging the shareholders to adopt the policy which he recommended. He well remembered that when the shareholders urged that the rate should be lowered from, he thought it was 3s. a word, they were met by the distinct opposition of the board, who said that such a course would be fatal to the interests of the company. The event had proved that the board was wrong in that respect. The question he wished to put to them now was, Might they not be wrong now in going to the other extreme? He fancied the shareholders' patience was becoming somewhat exhausted. Did they expect by a reduction of the tariff to 6d. a word to coerce Messrs. Mackay and Bennett into adopting a policy of friendliness? Messrs. Mackay and Bennett were not mere adventurers. They were wealthy men who had not come to England to find the capital for their enterprise, but had found it themselves. They had entered into a moral pledge with their proprietors that they would not raise the tariff beyond 1s. 8d. per word, or, if they did, that they would return to the shareholders 6d. per word for every message they had sent in the interval. That was a serious responsibility, and one that was accumulating every day, so that they were bound to keep the tariff at 1s. a word, whilst the combined companies desired to force them into some arrangement. He (Mr. Abbott) had always supported the board, but he thought at a juncture like this they ought to see whether there was any common sense in the company outside the board. He would like to know what damage would accrue supposing they raised the rate to the same level as the Commercial Cable Company. Such men as Sir Daniel Gooch, Sir James Anderson, Mr. Weaver, and other members of the board, who had been connected with Atlantic telegraphy since its inception, of course knew more than he did, but the shareholders wanted that point cleared up. This company was in a specially advantageous position: they had four cables working, including the Direct United States, and, therefore, it was a case of the victory resting with the best man; whoever did the business best would get the traffic. With regard to the secession of the French cable, he said the Anglo-American Company always seemed unfortunate in its alliances. By their hard-and-fast alliance with the Western Union Company they were to be safe for all time, so far as American messages were concerned, and it came as a surprise to them when they heard that Jay Gould had laid cables for himself. However, he hoped they would be successful in their legal process against the French people and make them refund some of the money which they had taken. He wished also to suggest the possibility of reducing their capital account. In all the speculative prospectuses issued by enterprising cable makers it was said that this company had four cables and a capital of £7,000,000. That capital was only on paper. It was perfectly true that in the years of their prosperity a large amount of the revenue, which otherwise might have gone to the shareholders, had been devoted to the renewal of their property, and they had duplicate cables which had been constructed largely out of revenue. The actual market value of the capital was not £3,000,000. If they were to show that the Anglo-American paid 3½ per cent., that it had four cables, and £1,000,000 sterling as a reserve, he thought it would have a deterrent effect upon those speculative enterprisers. The chairman had alluded to the extraordinary fascination which seemed to possess men to put money into competing cables. The last scheme was such an abortion that he did not think they need treat it as serious, and he thought they might regard themselves as safe from competition for many years.

Mr. Smith, of York, spoke in support of the policy of the directors in reducing the tariff to 6d. per word; and Mr. Jackson, Mr. Griffiths, Mr. Newton, and others, having addressed the meeting,

The Chairman replied, and said that it was a great encouragement to the directors to find that they had the support of the great body of shareholders. In reply to Mr. Abbott, he said that the tariff was not intended as a fighting tariff, but it had been adopted to test how far low prices for transmission would develop the traffic. He did not approve of reducing their capital, because if they paid a dividend it would appear to be so much greater than it was in reality, and that in itself would bring about competition. With regard to applying the interest in the future from the renewal fund to dividends, the directors would consider carefully before the month of May what should be done in that respect.

The motion was then put and carried unanimously, and the retiring directors and auditors having been re-elected,

A vote of thanks to the chairman and directors terminated the proceedings.

The India Rubber, Gutta Percha, and Telegraph Works Company, Limited.

THE directors' report for the year ending December 31st, 1886, states that the annexed accounts show the net profit for the past year to be £59,408 5s. 2d. Adding £40,947 8s. 3d. brought forward, and deducting £20,800 interim dividend paid in July, there remains a disposable balance of £79,555 13s. 5d.

The directors recommend the distribution of a dividend of £1 per share, free of income tax, amounting to £41,600, making, with the interim dividend, a total payment for the year of 15 per cent., and leaving £37,955 13s. 5d. to be carried forward.

The business done has been up to the average, notwithstanding the general depression, and the keen and increasing competition in our special trades.

The company's 6 per cent. mortgage debentures for £100,000, having matured in March, were paid off, and have been replaced by 4½ per cent. debentures for £200,000, having ten years to run. This increase has enabled the company to reduce its general liabilities by an equivalent amount, and to work financially with greater convenience.

The laying of the West African Telegraph Company's cables has been completed to the entire satisfaction of its directors and engineers. The West African and African direct systems of cables now include over 3,500 miles manufactured and laid by this company, and the directors feel satisfaction in reporting that the whole operations were carried out with complete success. The cables were laid on a difficult and unhealthy coast under the able management of Mr. Matthew Hamilton Gray, to whom as well as to the whole staff employed the thanks of the company are due. A small steamer, the *Buccaneer*, was purchased for use in the near shore work of the expedition, and was found most useful.

The Silvertown works have now been completely fitted up, by our own staff, with the electric light. There are 140 arc lights and 1,300 incandescent lamps, forming one of the largest installations in the world. The result is a great saving in cost and a great increase of light, while the health and comfort of the work-people and the facilities of working are much improved.

The company's works, machinery, and vessels are all in first-rate order.

Maxim-Weston Electric Company, Limited.—The secretary of this company states that the directors hope to have the accounts for last year published within a few days, and it is considered that they will be found very satisfactory, as the business done during the past year is much in excess of that for any previous year.

The Telegraph Construction and Maintenance Company, Limited.—The directors propose paying (subject to the audit of accounts) a dividend of 15 per cent. (£1 16s. per share), in addition to the 5 per cent. already paid, making 20 per cent. for the year 1886.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines of this company during the month of January was 3,956, estimated to produce £3,200, against 3,485 messages, producing £2,891 in the corresponding month of last year. The receipts for the month of October, estimated at £2,400, realised £2,415.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending February 4th were £2,828 after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The Great Northern Telegraph Company, Limited. The receipts for January, 1887, were £20,400; in the corresponding month, 1886, £19,880; and of 1885, £20,800.

The West Coast of America Telegraph Company, Limited. The gross earnings for the month ending January 31st were £5,875.

NEW PATENTS—1887.

1331. "Commutator brushes or contact pieces for electrical apparatus." D. HALPIN, I. A. TIMMIS. Dated January 27.

1333. "Oxidising and decomposing by electrical action organic matter and inorganic salts in sewage, water, &c." W. WEBSTER. Dated January 27.

1337. "Galvanic cells." N. W. PERRY, F. FORCHHEIMER, H. JENNEY, H. J. GROESBECK. Dated January 27. (*Complete.*)

1390. "Dynamo-electric machines and electro-magnets." R. C. JACKSON. Dated January 28.

1393. "Underground conduits for electrical conductors; means for distributing the conductors therefrom." A. J. BOULT. (Communicated by J. F. Munsie.) Dated January 28. (*Complete.*)

1400. "Automatic apparatus for subjecting the person to the action of electric currents." A. LOISEAU, O. PIERRARD. Dated January 28. (*Complete.*)

1408. "Magnetic attachment for chess or drafts, and other purposes." S. J. H. ROW. Dated January 28.

1499. "Laying underground wires for use as conductors of electricity." T. O. CALLENDER. Dated January 31.

1522. "Laying underground electric conductors." D. BROOKS. Dated February 1. (*Complete.*)

1527. "Autographic telegraph." H. J. ALLISON. (Communicated by the Writing Telegraph Company.) Dated February 1. (*Complete.*)

1531, "Electric lighting apparatus for locomotive engines." H. S. PYLE. Dated February 1.

1549. "Giving shocks of electricity or magnetism automatically by placing a coin or coins to work apparatus." F. E. STUART. Dated February 1.

1570. "Circuit closing apparatus for electric brake and other circuits." E. E. RIES. Dated February 1. (*Complete.*)

1571. "Operating electric brakes for railways." E. E. RIES. Dated February 1. (*Complete.*)

1584. "Electric signals for engines." J. C. RICKETSON. Dated February 1. (*Complete.*)

1595. "Electrical batteries." W. and A. BEISSBARTH, C. FLEISCHMANN. Dated February 1.

1609. "Electrically wound clocks." W. J. BARNSDALE. Dated February 1.

1628. "Electrical measuring instruments." W. T. GOOLDEN, S. EVERSHED. Dated February 2.

1654. "Closing or sealing secondary battery cells." W. KINGSLAND. Dated February 2.

1656. "Preventing escape of noxious fumes or other gases from electric batteries." M. BAILEY, J. WARNER. Dated February 2.

1659. "Telephonic cables." E. DE PASS. (Communicated by La Société d'Exploitation des Cables Electriques système Berthoud, Borel et Cie.) Dated February 2.

1667. "Applying electricity to illuminative and other purposes in theatrical, &c., representations." W. MCMULLIN. Dated February 2.

1686. "Machinery for covering wire with insulating material." W. S. SMITH. Dated February 2.

1693. "Disc dynamo or magneto-electric machines." C. D. ABEL. (Communicated by La Cie. Continentale Edison.) Dated February 2.

1738. "Dynamo-electric machines." C. D. ABEL. (Communicated by Siemens and Halske.) Dated February 3.

1741. "Apparatus of the two pole type for making and breaking electrical circuits." S. SUDWORTH, C. K. FALKENSTEIN. Dated February 3.

1742. "Apparatus for making and breaking electrical circuits." S. SUDWORTH, C. K. FALKENSTEIN. Dated February 3.

1744. "Accumulators of electricity, and making same." O. CHAUER, S. RABAY. Dated February 3.

1750. "Electro-deposition of aluminium, apparatus therefor." H. H. LAKE. (Communicated by Count R. de Montgelas.) Dated February 3. (*Complete.*)

1752. "Electric batteries." H. H. LAKE. (Communicated by Count Rudolphe de Montgelas.) Dated February 3. (*Complete.*)

1775. "Electro-plating rollers used in calico printing, paper staining, &c." G. FREEMANTLE. Dated February 4.

1862. "Secondary batteries." C. D. ABEL. (Communicated by A. Dun and F. Hasslacher.) Dated February 5.

1866. "Means of isolating electrical machinery for the purpose of preventing the transmission of vibrations." J. DAVIES. Dated February 5.

1904. "Transformers." G. KAPP, W. H. SNELL, J. M. V. KENT. Dated February 7.

1929. "Galvanic batteries." C. D. ABEL. (Communicated by A. Dun and F. Hasslacher.) Dated February 7.

1942. "Acoustic or mechanical telephones." C. AUTY, F. MORI. Dated February 8.

1952. "Electric light and other switches." A. F. DEWAR, F. WILSON. Dated February 8.

1953. "Telephone support." S. ROSENBLATT. Dated February 8. (*Complete.*)

1959. "Telephonic receivers." J. L. CORBETT. Dated February 8.

1982. "Transformation of heat into electricity by means of the thermopile." G. E. DORMAN. Dated February 8.

1993. "Apparatus for electrolysing bleaching solutions." E. HERMITE, E. J. PATERSON, C. F. COOPER. Dated February 8.

2022. "Apparatus for recording sounds." T. HESKIN. Dated February 9.

2028. "Electric batteries." P. JOLIN. Dated February 9.

2029. "Electric bells." P. JOLIN. Dated February 9.

2050. "Galvanic batteries." G. WEHR. Dated February 9.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1885.

42. "Improvements in volta-inductors." C. D. ABEL. (Communicated from abroad by the firm of Siemens & Halske, of Berlin.) Dated January 1. 6d. Claims:—1. In volta-inductors tubularly surrounded with iron, the use of cables of insulated wires and their connections, as described. 2. Covering the cables referred to in the preceding claim with lead for ensuring better insulation of their wires. 3. Covering the cables above referred to with iron wire or plate for strengthening the induction. 4. Covering the cables such as are above referred to with iron plates, slit so as to pass over them.

136. "Improvements in electrical tramways or railways." R. E. B. CROMPTON and J. H. F. SOLL. Dated January 5. 11d. Claims:—1. In an electrical tramway the construction or arrangement of a conductor or conductors, formed of a strip held with its rubbing surface or surfaces in a vertical direction, so as to allow the collector or collectors to have vertical play, as set forth. 2. In an electrical tramway, mounting the conductor or conductors on springs, substantially as set forth. 3. In an electrical tramway, supporting the conductor or conductors on springs or other supports curved or sloped to facilitate the moisture getting away, substantially as set forth. 4. In an electrical tramway, the arrangement or construction of a collecting attachment arranged so that it can be withdrawn through the narrow channel in the culvert. 5. In electrical tramways, the construction or arrangement and use of culverts and conductors, substantially as set forth, so as to admit of their being more easily scraped and cleaned. 6. For use in electrical tramways, the construction or arrangement of apparatus for scraping and cleaning the culverts, substantially as described. 7. For use in electrical tramways, apparatus for wiping and greasing the conductor or conductors constructed or arranged, substantially as set forth. 8. In electrical tramway apparatus, greasing the conductor or conductors with an insulating grease or lubricant, as set forth. 9. In electrical tramways the construction or arrangement in combination, substantially in the manner set forth, of the parts of culverts so that cleansing is facilitated, with conductors of the character described so arranged as to be easily accessible to the greasing or lubricating means. 10. In electrical tramways the construction or arrangement in combination of a culvert formed as described with a conductor formed of a strip held in a vertical direction by springs or supports curved or sloped to facilitate running off of the moisture, substantially as set forth.

1034. "Improvements in and connected with electric and other cables and ropes." G. SUTTON and W. T. HENLEY'S TELEGRAPH WORKS COMPANY. Dated January 23. 8d. Consists in covering the insulated conductors or cores with a braiding or plaiting of more or less fine metallic wires while in the case of large cables or ropes an alternate or other series of layers of material and braided or plaited wires may be employed. Claim: The improved rope or cable having one or more braided or plaited jackets or coverings of wire, substantially as and for the purpose set forth.

CORRESPONDENCE.

Trembling Bells.

In your issue of January 21st, page 67, Prof. S. P. Thompson states that the trembling bell constructed by me is practically identical with one described in the *Electrotechnische Zeitschrift* for 1883. The bell referred to is probably that of Mr. Lippens, described on page 271 of the latter Journal. If I am right in this presumption, I venture to say that the two bells compared are neither theoretically nor practically identical. It is conceded that Mr. Lippens also uses an auxiliary lever, but the connections are not made in the same way. His bell consequently *breaks* the main circuit and *short circuits* the magnet during a period

equal to that of ordinary trembling bells, thus offering the inconveniences of both make-and-break and short circuiting bells. My bell never breaks the main circuit; the short circuiting is reduced to the smallest possible period, and is practically harmless.

As to complication of leverage in my bell, I will not contest with Prof. Thompson. I will only state that the application of a second lever affords a very delicate regulation of the armature spring, thus facilitating the play of the hammer at the moment most needed, viz., at the starting point, or at the remotest position of the armature. The sticking of armature, which would be the consequence of a feeble spring, is here prevented by the auxiliary lever spring, applied with sufficient force and at the proper moment.

The conditions of rapidity of action seem not to be very well considered in an electro-magnet, in which only *half* the number of spirals is useful in attracting the armature, while *all* the spirals are pervaded by the extra current generated by the fall of magnetism.

M. Wennman.

Secondary Batteries.

Your Journal has recently contained a number of letters about secondary batteries. From this and a paragraph about the Union Company's cells, I gather that this company are proposing to use plates of peroxide of lead. Will you allow me to say that my late husband patented the use of plates consisting solely of peroxide of lead as far back as 1882. The patents taken out by him are now in my possession, and the Union Company, who are working under patents of a much more recent date, are undoubtedly infringing.

A candid examination will show that at the present time I hold the exclusive right to the manufacture, limited to those now described as being made by the Union Company.

Caroline Romilly Tribe.

Incandescent Lamp Patents.

There are special reasons why I can speak on this subject with exceptional authority and knowledge as regards what was done in the early stages, the period on which all important patent rights turn.

From the first commencement of Lane-Fox's work I was convinced of its importance.

As engineer to the British Electric Light Company, Limited, I drew the first agreement he made in connection with his patents.

Under my immediate notice thousands of pounds were spent on his work, so little excuse is needed from me in endeavouring to get his actual work and the points he developed well recognised. That they should be is, for obvious reasons, of great and immediate importance to the prosperity (in this not very go-ahead country in electrical matters) of electric lighting and distribution.

I feel strongly that the expenditure that the directors of the British Electric Light Company, Limited, went to, after sifting this matter which I brought before them, bore important results, and the British Electric Light Company pioneered important work in this, as they did in many branches of the heavy electric development of the last 10 years.

The high-resistance system of incandescent lighting as it now exists was first described in one of Lane-Fox's patents, October, 1878. Let any one interested read that patent, and they will there see in all its entirety and scientific accuracy the system of incandescent lighting now common. There is no disputing the fact that Lane-Fox was the pioneer and the exponent of the system of high-resistance light-giving media in a parallel circuit system of distribution with constant potential, which is, in fact, "the incandescent lighting of to-day."

Edison at a later date than this deals with another method of working *vide* his specification later (in 1878) than Lane-Fox's above-referred to, where he describes his tuning-fork dynamo and elaborate arrangements for adjusting current to lamps in series, showing the total divergence of his ideas from Lane-Fox's.

The system described by Lane-Fox is the system now in use: the practical incandescent system of lighting.

Is the method detailed at a later date by Edison practical, either electrically or commercially? I unhesitatingly say, no.

So far for the system and scientific principle to be followed; now as to a point or two of practical detail.

In the Court of Appeal on 31st ult. Lane-Fox's patents were lightly touched upon, but they were not *dealt* with.

Lord Justice Fry, speaking for himself and Lord Justice Bowen, says the result of this review of all the alleged anticipations of the second claim of Edison's patent of November, 1879, is to convince us that there was no case which brought together all the five elements which we have pointed out as combined in Mr. Edison's second claim, *carbon* in a *filamentous* form in a *vacuo*, and in a *receiver entirely* of glass through which the *leading wires pass*.

Now, as Lane-Fox's patents have been touched on by the judges, the public will naturally assume that Lane-Fox's patents had little or nothing tending to affect their decision.

I repeat, the fact is Lane-Fox's connection with the subject has been touched on very lightly, but has not been *dealt* with.

Now let us see whether these five elements above referred to, viz., carbon in a filamentous form, in a vacuo, and receiver entirely of glass, through which leading wires pass, did not exist before Edison's patent of November, 1879.

It must be remembered that at this date Lane-Fox had been hard at work in his laboratory for some time; his first patents were more than a year old.

Well, prior to this patent of Edison, Lane-Fox had described exhausting (*not refilling* again with nitrogen, &c., unless specially desired; his object in putting in nitrogen when he did was to balance atmospheric pressure and diminish chances of leaking, which was then his great difficulty). He had described *sealing the wires* through the *glass bulb*, the *vacuum* and *carbon*. So far, we have four of the five points. *Glass; vacuum; leading wires sealed* in; *carbon*. The only point not touched on is "filament" or filamentous.

In order to make the point more striking, let us take Edison's own definition of filament in this very patent. He described mixing a paste, and cuts his "sheets" or "wires" of carbon from it.

Long before this, Lane-Fox had made his bridges, as he called them, usually of horseshoe form, by moulding under great pressure (certainly a better method than rolling). Edison describes in his patent ("the" patent) mixing his filament paste with non-conductors to increase the resistance; Lane-Fox had previously done this. Lane-Fox had *even* some time before this specified carbonised asbestos, stating that it could be woven or used in the form of paper.

It appears, therefore, that long before the date of this November, 1879, patent of Edison's, Lane-Fox had all these five points cited by the judges. It was remarked that there was no evidence that the Lane-Fox lamp ever gave a ray of light.

This case was not fought on what Lane-Fox had done. So far as I know there was no attempt made to show what he had done, or was any Lane-Fox evidence offered.

The Lane-Fox patents were the outcome of hard practical laboratory work, and there is, I imagine, plenty of evidence as to what he did, and that the lamps not only gave a ray of light, but that many lamps were actually made and worked which were just as successful as those made by Edison at that period.

Radcliffe Ward.

February 9th, 1887.

Ancient Installation.

We should esteem it a great favour if you would allow us to ask through your valuable journal if any of your readers could give, or assist us in obtaining, the following information, viz. :—

(1.) The type of incandescent lamps used by several shopkeepers during the electric lighting experiments carried out at Deal in the year 1855 ; also the names of any workman engaged in and upon these experiments.

(2.) The name of the electrician who had charge of the domestic electric lighting plant at a certain house in Pembridge Square, Bayswater, during the winter in the year 1874.

(3.) The present address of Mr. William Tooth who carried on business as a glass manufacturer and tube maker at Sunderland during 1870 to 1877.

(4.) The present address of David Capner, glass blower to the late Mr. C. W. Harrison, and who resided in Fetter Lane in the year 1876 ; or Mr. William Slater, of Richmond, assistant electrician to Mr. Harrison during the year of 1876 or 1877.

(5.) The present address of Frederick Hayward, mercurial pump maker, who lived in Cow Cross Street, Smithfield, in the year 1877 ; at present believed to be employed in a Boston or New York firm.

Shippey Brothers.

February 3rd, 1887.

The Bernstein Lamp.

Numerous enquiries have reached me of late from various persons who ask whether the last decision in the matter of the Edison patents affects my new lamp of low resistance, and I therefore beg permission to reply through the medium of your esteemed paper.

The decision makes it clear, that of the four claims of the Edison patents only the second one is of importance.

This claim protects the combination of a carbon *filament* with an exhausted glass receiver, through which the leading wires pass. It was conceded by the judges that the Swan lamp was a combination of a carbon with a receiver made entirely of glass, and leading wires passed through the glass ; but it was argued that the Swan lamp was a failure because the carbon was too thick, and that by the introduction of the *filament* the Edison lamp became a success. The Swan carbon, which in the judgment is called a carbon rod, was $\frac{1}{32}$ of an inch in diameter ; the carbons which I am using in my lamps have a diameter of $\frac{1}{22}$ of an inch.

This at once settles the question.

I may be allowed to repeat that in whatever manner the pending case respecting the Sawyer patent may be decided, the judgment will not affect me, as the carbons in my lamps are made without the use of any process for depositing carbon.

A. Bernstein
(*Per* T. S. G.).

February 7th, 1887.

Electrical Fire Risk.

With regard to a letter in your last week's issue bearing on the above subject, I am instructed to say on behalf of the insurance interests I represent that so complete is their confidence in the "Rules for Electric Light Installations" used in this country to prevent fire, that electrical installations placed up in accordance with them are being allowed in buildings without any extra charge whatever, notwithstanding that gas and other illuminants are used concurrently ; and that they engage to pay any loss or damage occasioned by such installation without any additional premium.

That the bare recital of this fact they consider a complete practical answer to any doubts that may exist in the mind of any person as to the efficacy and completeness of the present rules to prevent fire. Also that not a single loss has yet occurred in any building from any electrical installation when such installation has been put up in compliance with them. The trouble that may have arisen has been due to the fact of the installation not having been placed up in accordance with the "rules."

I am further instructed to say that the rules for electric light installations used are not the ones described as settled by the committee mentioned, but those that were in use and which had reached the third edition before such committee was even formed, and the ninth edition of which was issued in January of this present year. And that should any modification be required at a future time, they feel quite competent to frame such alteration themselves, they making it a point to understand their own business.

That, as the matter of fire risk is one of vital importance to them, should any attempt be made to introduce new rules, such rules will be ignored ; and no statement by the assured that the electrical work on his premises has been placed up in accordance with them will be accepted. They wish this to be distinctly understood in the event of such electrical work not getting passed, or any risk due to it not being gratuitously accepted.

That, at the present time nothing can exceed the good feeling existing between themselves and the leading electrical companies, nor the smoothness with which every matter connected with the fire risk of their installations is arranged without trouble to the assured.

Also that if any information is required concerning any electrical installation, it must be obtained from other sources, for nothing whatever will be divulged, no matter what interest may wish to be served—public or otherwise.

I am requested to ask you to kindly publish this letter in full in your next issue, as the communication previously referred to might create erroneous impressions.

Musgrave Heaphy.

February 9th, 1887.

The Valve Telephone.

The question which you ask in your issue of February 4th is readily answered. A carbon valve cut from a piece of dense retort carbon (an excellent conductor of electricity as everybody knows) was used in the first Valve telephone constructed by Mr. Jolin and myself ; and carbon valves made from hard electric light pencils have been used in the great majority of all the instruments supplied to the public by the New Telephone Company. The alloys of copper, selenium, &c., which were at one time preferred on account of their more crisp and distinct articulation were found unsatisfactory for work in damp places, as the moisture gave rise to local action at the contacts. No change whatever has been made in the Valve telephone since the summer of 1885.

Silvanus P. Thompson.

February 8th, 1887.

The Edison Filament.

I have read, with interest, the judgment in the late incandescent lamp case, and have in common, I dare say, with many of your readers, been much surprised and disappointed that no definition is therein given as to what resistance of filament constitutes an infringement of Edison's patent.

Edison mentions "from 100 to 400 ohms," but this is obviously meaningless, unless a certain length is specified, and whether the measurement is to be taken with the lamp hot or cold.

Is a 16 C.P. lamp, taking 1 ampère at 50 volts, an infringement ? Or is the Bernstein 2 ampère 50 volt lamp clear ?

It would be interesting to know what the plaintiffs themselves say on this point.

G. H. Bays, Jun.

February 7th, 1887.